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PAPILLEDEMA AND OPTIC NEURITIS

A RETROSPECT

LESLIE PATON, M.B., F.R.C.S.

Consulting Ophthalmic Surgeon, St. Mary's Hospital, and Senior Ophthalmic Surgeon, National Hospital for Nervous Diseases, Queen Square

LONDON, ENGLAND

My first and most pleasant duty is to thank the American Medical Association, and especially its Section on Ophthalmology, for the very great compliment that the Council on Scientific Assembly has paid me in inviting me to be present on this occasion. I regard it as one of the greatest honors that have been paid to me during my ophthalmologic life, and my only regret is for the inadequate way in which I can show my gratitude. The choice of a subject for an address has been a matter of great difficulty to me. Of recent years a good deal of my time has, of necessity, been given up to work with no definite scientific bearing; routine work connected with the councils and committees of various kinds which falls to one's lot as one gets older. Many of those who are somewhat senior know how this type of business more and more encroaches on the leisure which might otherwise have been free for scientific or clinical research. It was the thought that I had nothing new or original to offer which made me hesitate for some time before accepting the invitation. I have, however, concluded that it may be of interest to the Section on Ophthalmology if I deal with a subject which more than any other has always been of interest to me: the conditions in the optic nerve and nerve head produced in certain disturbances of the central nervous system. I propose to deal with the subject primarily in a retrospective fashion.

I first went to the National Hospital for Nervous Diseases, familiarly known to all neurologists as "Queen Square," as an assistant to Marcus Gunn in the year 1902. At that time Gowers, Ferrier, Horsley, Buzzard, Risien Russell and others were still actively working there. Hughlings Jackson was still a regular visitor to the wards and a source of inspiration to all his juniors. These were all very much my seniors. But I was specially lucky in the men who were more definitely my contemporaries as registrars, house physicians or pathologists. In my early years of work in the hospital and pathologic laboratory, Farquhar Buzzard, H. Douglas Singer, Gordon Holmes, Kinnier Wilson, Barnes,

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Foster Kennedy, Godwin Greenfield and others who have since attained fame in the neurologic world were among the house men with whom I was most closely associated.

In those days it was the custom to talk about optic neuritis simply, and the main distinction made was between a neuritis associated with changes in the disk and a neuritis affecting only the nerve behind the eye and not associated with obvious swelling of the disk (retrobulbar). If the swelling in the disk was great it was called "*Stauungspapille*," or "choked disk," but that was regarded as only an exaggerated form of optic neuritis. There was no clear distinction between different forms of optic neuritis as it affected the nerve head, nor was there any too clear a distinction between different varieties of retrobulbar neuritis, except that it was recognized that one form was associated with disseminated sclerosis. But one did recognize that a definite distinction existed between neuroretinitis in which the disk was affected as part of a general retinitis and optic neuritis in which the retina was affected only by edema spreading from the disk.

I am only trying to recall the general atmosphere with regard to those subjects which existed in the early years of the century when I first began to take an interest in them. And yet already there existed in clinical studies the germ of ideas which led to a clearer knowledge of the nature of some of the changes. As early as 1865 Hughlings Jackson had called attention to the fact that so-called optic neuritis could exist without any loss of function, and in a lecture published in *The Medical Times and Gazette* of 1871 he recapitulated a numerous series of papers written in the preceding decade. It is from that lecture I quote: "For it is quite certain that there may be extensive changes of neuritis . . . when the patient does not know that there is anything the matter with his sight and when he can read the very smallest of our test types . . . . Indeed optic neuritis may be altogether overlooked by those who do not use the ophthalmoscope by routine in cerebral cases as the neuritis may retrocede" without defect of sight. In passing I may say that that particular lecture contains a very fine clinical picture of the optic nerve conditions in cerebral tumor, and it is well worth studying today.[1]

Hughlings Jackson recognized definitely that a swelling of the disk could exist without any loss of function. Here was a very definite sign-post, a condition existing called "neuritis," and yet two of the cardinal signs of inflammation were lacking: there was no pain, and there was no loss of function. It was only later, when accurate observations were made, that it was found that the swelling of the disk

1. Taylor, J.: Selected writings of John Hughlings Jackson, London, Hodder & Stoughton, Ltd., 1932, vol. 2, p. 251.

was unassociated with any histologic sign of inflammation other than swelling and venous turgescence. On the other hand, it was recognized that cases existed in which loss of function preceded any evidence of ophthalmoscopic change. In a few of these cases the condition subsequently progressed to optic atrophy, that is, a white atrophic-looking disk, even in cases in which seeming complete recovery of function took place.

So there existed definite clinical evidence of two types. In 1908 Parsons introduced into English from a paper by Elschnig the use of the term "papilledema" to replace the term "*Stauungspapille*" for cases which showed more than 2 diopters of swelling, while retaining the term "papillitis" for more moderate degrees of optic neuritis. And in 1911 Holmes and I adopted the term to describe all the cases of edema of the nerve head due to raised intracranial pressure, and distinguished between papilledema with no primary inflammatory changes and papillitis in which the swelling of the disk was associated with inflammatory changes and loss of function. True optic neuritis, as distinguished from papilledema, was then regarded as manifesting itself in two ways, either as retrobulbar neuritis or, associated with disk changes, as papillitis, the only essential difference being in the site of the inflammatory change.

I. PAPILLEDEMA

If in papilledema there is no evidence of inflammatory change, what is the mechanism which gives rise to this edema? I have seen no cause to modify in any serious way the hypothesis that Holmes and I promulgated in 1911. In brief, our statement was that the rise of the pressure in intracranial fluids was transmitted from the cisterna basalis along the optic nerve sheaths. In order to maintain the circulation in the intravaginal portion of the central vein against this raised sheath pressure there was a rise in venous pressure in the central vein and, in consequence, in the whole retinal circulation. This obvious venous engorgement resulted in increased formation of lymph. At the same time, the main lymph channels draining the disk and posterior part of the retina pass back into the nerve sheath and the increased sheath pressure blocks also the normal drainage of lymph. So the production of the edema and swelling of the disk is due to these two factors—increased production of lymph from raised venous pressure and blocked drainage of lymph.

The optic disk may be regarded as a fibrous sponge formed by the interlacing of the fibers of the pars choroidalis running across and the nerve fibers running in. As the meshes between these fibers fill with the lymph unable to escape by its usual channels down into the nerve

sheath, the fibers bulge out in every direction in which they can. Figure 1 shows the appearances in a case ten days after the first signs of swelling took place. It is seen that the strong fibers of the pars sclerotica of the lamina cribosa, which form the diaphragm between the two pressures, are unaffected by the edema, but on the inside the fibers of the pars choroidalis begin to show their forward convexity, and the lateral bundles of nerve fibers are beginning to bulge sideways. There is no evidence of any inflammatory change. Visual function was good though the papilledema was developing in a very rapid fashion. Nothing is visible histologically but a simple separating of the constituent fibers

Fig. 1.—The interlacing meshwork formed by the nerve fibers and the fibers of the pars choroidalis of the lamina cribrosa in an early papilledema (ten days).

of the optic disk by fluid. It has to be remembered that in all these specimens the necessary preparation with fixatives reduces the actual swelling as seen in life, and in some cases must do so considerably.

If now one looks at a later more fully developed stage of papilledema one can see all these changes more fully developed, though this section does not show the bulging of the pars choroidalis in such a diagrammatic form. It shows some features particularly well: the extreme lateral bulging of the outer bundles of nerve fibers and the consequent S-shaped course that they have to take to reach the retinal surface, the lifting up and folding of the retina and the consequent rupture of the connection

between the external limiting membrane and the membrane of Bruch, the congestion of the central vein immediately inside the pars sclerotica and numerous small congested vessels. It shows also that the membrana limitans interna has been detached as it lay over the central pit and has been bulged forward. Of course, this does not show in the prepared specimen, but you can see it lying wrinkled over the central pit.

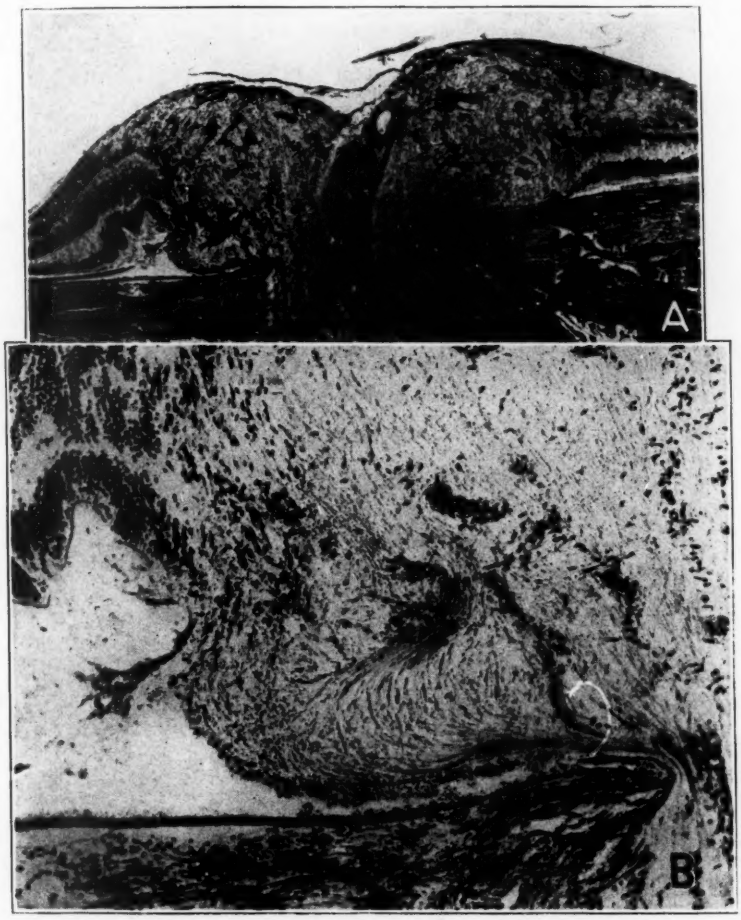

Fig. 2.—*A*, the forward and sideway bulging of the nerve fibers in the disk produced by the edema. The membrana limitans interna has been lifted off the physiologic pit by edema (collapsed in preparation). *B*, the rupture of the communication between the membrana limitans interna and the membranes of Bruch produced by the lateral bulging of the nerve fibers. The illustration also shows the folding in the retina produced by the lateral bulging.

A higher magnification (fig. 2 *B*) shows the details of the lateral bulge more easily. It shows the portion torn away from the membrane of Bruch and the connection with the external limiting membrane, and

it shows at one point a bundle of nerve fibers which have been held up by a loop of vessel.

The first appearance of any change in the edges of the disk is almost invariably at the upper and lower borders, and from there it spreads around the nasal margin, and often the outer margin may remain visible when all the others are completely blurred. The explanation of

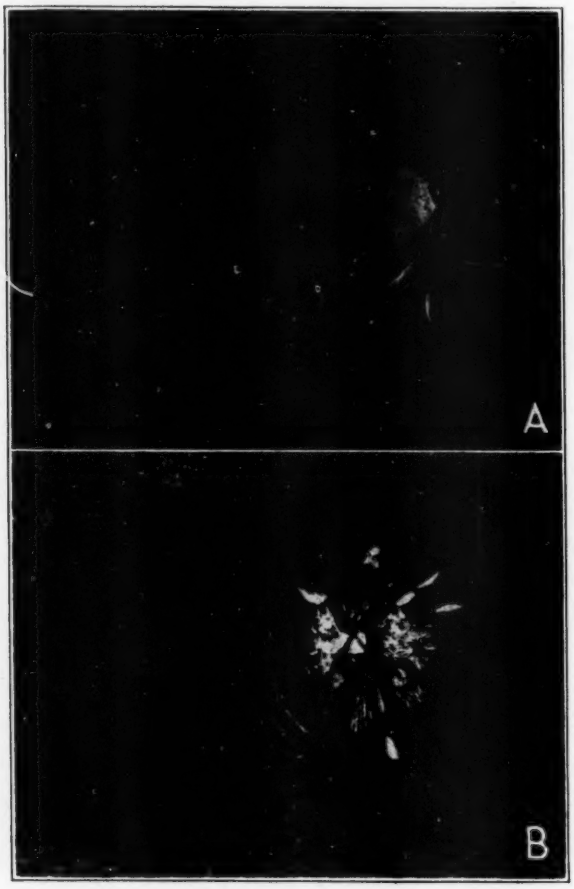

Fig. 3.—*A*, early stage of papilledema with blurring of the upper and lower margins, the outer margin being still clear; *B*, hemorrhages in intense papilledema with white areas of swelling nerve fibers and retinal folds.

this is based on the normal arrangement of the nerve fibers. The fibers constituting the papillomacular bundle occupy about two fifths of the circumference of the disk. The fibers going to the nasal half of the retina, governing much the largest visual field, occupy most of the nasal half. That leaves only approximately a tenth of the circumference of the disk for the whole of the rest of the fibers going to the temporal

half of the retina. The result is a crowding together of the fibers above and below (fig. 4), and when the edema occurs the blurring will show first and most where the fiber layers are thickest.

The hemorrhagic character varies greatly in different cases. In some cases, even with extreme swelling, there is little hemorrhage. It is usually most marked in the nerve fiber layer, where it assumes a striate character. The other area of capillary distribution in the retina is the

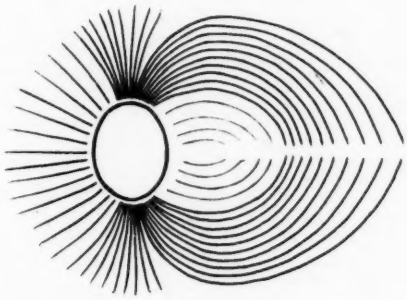

Fig. 4.—Diagram illustrating the crowding of the nerve fibers above and below the disk.

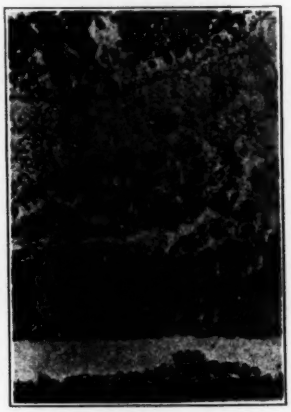

Fig. 5.—Cluster of macrophages at the site of an old hemorrhage in the outer molecular layer.

outer molecular layer, where the hemorrhages, when they occur, are dusky and blotlike. Figure 5 shows a clump of macrophages in the outer molecular layer, in what has been an old hemorrhage. I have seen cases with small punctate hemorrhages scattered all over the retina to the remotest periphery. In none of these cases did I get an opportunity to make a histologic examination, so I am unable to give any explanation of these peculiar cases.

In describing the appearance of the so-called macular fan in cases of papilledema in 1905 I gave my reasons for thinking that the bright spots that composed it were in the most superficial layers of the retina and were the result of an edematous fluid overflowing from the disk and running under the membrana limitans interna. I showed that the

Fig. 6.—*A*, older stage of papilledema with macular fan and soft white areas of swollen nerve fibers near the disk; *B*, section illustrating the formation of the macular fan. The membrana limitans interna is raised up into the vesicles, showing ruptured fibers of Müller in the vesicles.

presence of the macular fan was consistent with perfectly good vision, but it was only in 1911 that Holmes and I were able to show histologically that this was the correct explanation and that the spots were the

result of reflection from the bubble-like vesicles produced by rupture of the fibers of Müller and the raising up of the membrana limitans interna.

Normally edema spreading out along the nerve fibers of the retina is not in any way blocked or restricted but can flow out right to the periphery of the retina, except in the case of the papillomacular bundle; in the latter case its outflow is limited by the short course of these nerve fibers and further outflow can be accommodated only by forcing up the membrana limitans interna, and so one gets the familiar parabolic figure that is the usual result in cases of excessive edema. In many cases, also, it is evident ophthalmoscopically that the membrana limitans interna over the surface of the disk and over the physiologic pit is raised up by edematous fluid. In course of preparation the membrane

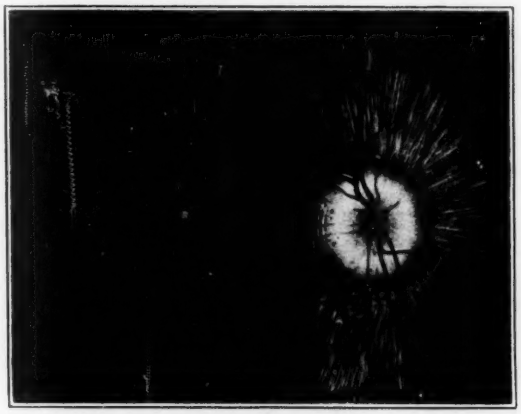

Fig. 7.—Retinal foldings accentuated by hemorrhages.

collapses, but in some cases it can be seen as a collapsed membrane over the pit, as in figure *2 A*. In high magnification the torn roots of the fibers of Müller can be seen adhering to the ruptured membrane in the vesicles.

The edema not only may rupture the internal membrane by pushing forward, but, as I have already said, it may rupture the membrane of Bruch and tear it away from its connection with the membrana limitans externa and push it sideways. This sideways swelling of the disk pushes the retina up into folds. These folds are often quite easily visible with the ophthalmoscope, and especially so when their presence is accentuated by hemorrhages.

It is obvious, therefore, that if the retina is shoved away from the edge of the disk in this fashion, there will be quite a definite enlargement of the blindspot, and that the disturbance of the pigment layer which takes place at the same time will be obvious, even after complete subsidence of the swelling in the area around the edge of the disk.

The peculiar rounded or oval bodies known as "cytoid bodies" were first described as occurring in cases of albuminuric retinitis as long ago as 1856. Müller later rightly showed their association with the nerve fibers. They were found to occur in many other conditions apart from albuminuric retinitis, and Tepljaschin showed that wounds and injuries to the retina would always produce them. They are responsible for the soft white areas in the nerve fiber layer on the disk or in the adjacent retina. For years the nature of the cytoid bodies puzzled me greatly, but ultimately Holmes and I were able to show conclusively that they resulted from the swelling up of the cement substance of the nerve fiber and the subsequent disintegration of the fibrillae composing the fiber.

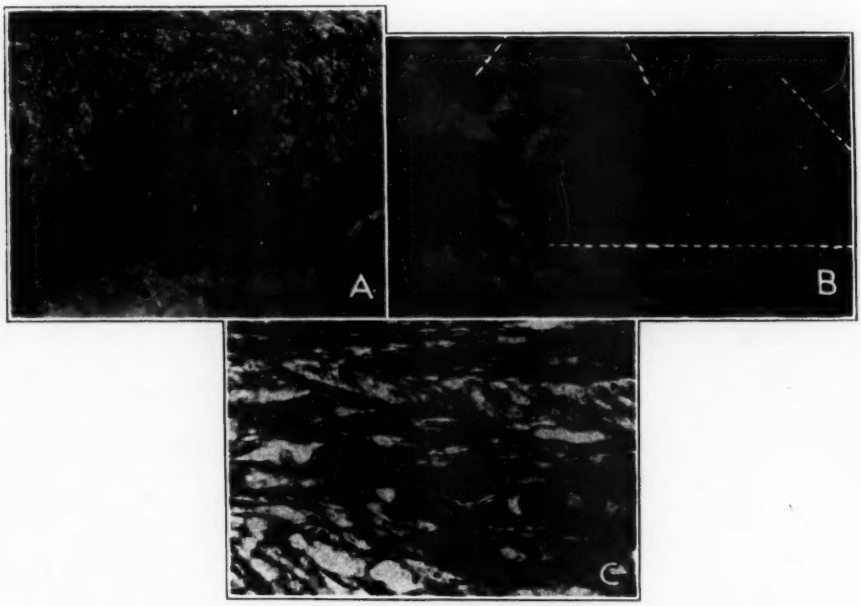

Fig. 8.—*A*, cytoid bodies in the ordinary hematoxylin Van Gieson preparation; *B*, cytoid bodies shown continuous with nerve fibrils; *C*, cytoid bodies shown produced by the swelling up of the interfibrillar cement substance and the subsequent fragmentation of the fibrillae.

The optic nerve is not a nerve at all but an outgrowth of the central nervous system. Embryologically, histologically and pathologically it behaves like the other conducting tissues of the central nervous system. Where it has a myelin sheath it suffers from the same diseases that other myelinated portions of the central nervous system suffer from. Inside the eye it only rarely retains any portion of myelin sheath. The reaction of its fibers to injury consists of a swelling up of the interfibrillar cement substance and a subsequent breaking up of the fibrils themselves.

On the occasion of my reading a paper entitled "Optic Neuritis in Cerebral Tumours" in 1908 considerable controversy was created by my statement that the statistics of my cases did not bear out the belief that a difference in the amount of swelling is of value as indicating the side of the brain on which the tumor is likely to be found. My subsequent experience of many years and many hundreds of cases only further confirms me in this belief. I should go further now and say that the percentage of cases in which there is any measurable difference in the amount of papilledema in the two eyes is much lower than I then thought. In by far the greater number of cases the swelling, when it is at its height, is nearly equal in the two eyes, and when one considers the mechanism by which it is thought the papilledema is produced one can see that this is the more probable condition: There is a general rise of pressure in the fluids in the skull, and pressure in a fluid is transmitted equally in all directions. Now, if both optic foramina

Fig. 9.—A dense band of connective tissue may prevent development of swelling in one part of the disk, leaving the physiologic pit clear.

are equally open, equal pressure will be transmitted from the cisterna basalis into the sheaths of both nerves and will give rise to equal obstruction of the venous return and lymph drainage from the disk, and so normally to equal appearances in the disk, and the swelling of the tissues of the disk will go on until the stretching of these tissues is such as to compensate for the increased pressure of fluid in the tissues. Now, Walter Parker has shown, in a paper published in 1916, that one of the factors which may cause an inequality of swelling in the two disks is an inequality in the intra-ocular tension, and that the eye with the lower intra-ocular tension will show swelling of the disk sooner than the other.

A further factor may be some difference in the tissue construction of the disk, and figure 9 demonstrates that the presence of a denser band of connective tissue at one part of the disk prevented the appearance of any swelling at that point. In this case, though the nasal half

of the disk was swollen to the height of 4.5 diopters, the outer half of the disk remained free from swelling. This particular illustration shows only how a density of connective tissue may prevent swelling at one part of the disk. But a difference in general tissue construction of the two disks may account for some of the cases of difference in the amount of swelling.

In a paper which I read in 1905 and in subsequent papers I spoke of the temporary attacks of amaurosis lasting from half a minute to an hour or more which occasionally occurred in cases of increased intracranial pressure, and I showed grounds for believing that these were not associated with the papilledema but might occur quite independently of disk changes, and that the probable cause was a temporary increase of pressure on the chiasma or intracranial portions of the optic nerves. In a subsequent paper, published in 1908, I adduced a series of cases—three frontal and one temporosphenoidal—in which the amaurosis was one-sided and on the side of the tumor. In these cases of amaurosis the raised pressure was intermittent, and the phenomenon was accompanied by other signs of temporary increase of intracranial pressure, such as increased headache and giddiness. I went on to say that if there was direct pressure on the nerve itself, the result was optic atrophy and not "optic neuritis." (In 1908 that term was still being used.) At the end of 1908 I had a postmortem opportunity of confirming my belief that a tumor at the anterior end of the temporosphenoidal lobe or on the under surface of the frontal lobe would cause atrophy of the collateral nerve and papilledema on the opposite side. This case is of some historical interest since it formed the subject of the last public lecture that Sir William Gowers gave, and I may quote the short description of the chiasma and nerves of that case: "The tumour lay above them and compressing them and it had pressed back the optic chiasma. The left nerve had evidently suffered more compression than the right. There was no distention of the sheath of the left nerve, but moderate distention of the right sheath just behind the eye-ball. The left optic nerve had evidently suffered longer and greater compression than the right." I may add to Gowers' description that the tumor had blocked the left optic foramen. My examination of these nerves showed that the seat of degeneration in the left optic nerve occurred in the very short piece of the nerve between the chiasma and the optic foramen. This was stretched because the optic chiasma was being pushed backward by the growth. The largest patch of degeneration occupied the outer part of the nerve, the position which is occupied by the macular fibers in the intracranial portion of the nerve. Gowers, in his lecture, said: "Any case which presents this condition [i. e., atrophy in one eye and papilledema in the other] will probably warrant the same diag-

nosis." In his own words: "You may assume that the optic neuritis produced by an ordinary intracranial tumour is always produced in both eyes." He quotes the one exception: "In this the mononuclear neuritis from cerebral disease having the symptoms of a tumour was confined to the right eye, but . . . the left was artificial!"

This thesis was developed at greater length by Foster Kennedy.[2] In rare cases, the appearance of optic atrophy in one eye and papilledema in the other has proved a very valuable indication of the location of the tumor either in the anterior end of the temporosphenoidal lobe or in the base of the frontal lobe on the side collateral with the atrophy.

II. OPTIC NEURITIS

The second part of my subject, true optic neuritis, is much more difficult to deal with in a brief fashion, and I propose to limit myself mainly to the types which I have met with in a neurologic clinic. By doing so I leave untouched cases in which the optic nerve is affected by local orbital infections or by septic conditions in the adjoining accessory sinuses, etc. I omit also syphilitic, tuberculous and rheumatic involvements about the apex of the orbit. On the big subject of tabetic atrophy I wish only to reiterate what I said in 1922 when I concluded from a careful examination of the visual fields and the variability in the type of visual loss that the attack on the nerve might in some cases be interstitial and in other cases parenchymatous.[3] In other words, the optic nerve sometimes reacts like the posterior spinal roots in tabes and sometimes like the cerebrum in dementia paralytica.

In what remains of my time I speak of the obscure class of diseases in which a neurotropic virus attacks the optic nerves. Unfortunately, the identity of the virus in most cases is not clear, and until methods of separating and identifying the viruses have been arrived at, there will always remain a doubt as to whether clinical cases which seem to differ from one another may not owe their differences to a variation in the virulence of the poison or in the susceptibility of the tissues affected. Herpes ophthalmicus is one of the virus diseases which does rarely attack the optic nerve on the affected side and may cause blindness. There still exists a doubt as to whether herpes zoster and herpes fibrilis are due to the same or to different viruses. On the other hand, in my own mind there is little doubt that the virus of herpes zoster is closely allied to varicella, and if so, also to vaccinia. I have seen many cases of the close association of chickenpox and zoster, the one a dermatropic and

2. Kennedy, Foster: Retrobulbar Neuritis as an Exact Diagnostic Sign of Certain Tumors and Abscesses in the Frontal Lobes, Am. J. M. Sc. **142**:355, 1911.

3. Paton, Leslie: Tabes and Optic Atrophy, Brit. J. Ophth. **6**:289 (July) 1922.

the other a neurotropic manifestation of the virus. I am ashamed to say that when I first came across optic neuritis associated with herpes ophthalmicus I regarded it as an undescribed complication. It is certainly a rare one, but Jonathan Hutchinson described a case in 1866, and at intervals since then cases have been recorded. In 1923 I had two cases within a few months of each other, both resulting in blindness in the affected eye.[4] The association of herpes with chickenpox is of interest, however, from another aspect. The only case of acute disseminated encephalomyelitis which I have seen followed an attack of chickenpox, and seemingly most of the reported cases of this condition follow varicella, vaccinia or measles.

But disseminated encephalomyelitis is only one of the four virus infections in which optic neuritis is a definite and predominant symptom, and it is still in doubt as to whether one is justified in treating the disorder as other than a clinical variety of disseminated sclerosis. It is all so speculative at present, this question of the interrelationship of all the virus diseases. It almost seems as if in the future the differences will resolve themselves as the differences in the atoms have resolved themselves into variations in the relationships of protons and electrons and these in their turn to radiations of varying wavelength.

The common feature of the four virus infections of which I speak is their liability to attack the optic nerve in the early acute stage of their incidence, and the fact that the first tissue to be attacked is the myelin sheath, whether it is in the optic nerve, in the centrum ovale or the tracts of the spinal cord.

The prototype of the class is (1) disseminated sclerosis with all its protean clinical manifestations and varied course. The other three types are (2) acute disseminated encephalomyelitis, (3) acute ascending myelitis, neuromyelitis optica of the French, or Devic's disease, and (4) diffuse periaxial encephalitis, or Schilder's disease.

These are all definitely demyelinating diseases, and in consequence the optic neuritis is of the retrobulbar type with characteristic pain and loss of function, but if the site of the lesion is forward in the nerve, in front of the point of entry of the central vessels, there will be a blockage of venous and lymph return from the disk and consequent edema of the disk. I believe a slight degree of this edema is much commoner than is suspected.

In some cases the swelling and hemorrhage of the papilla are so marked as to give rise to mistakes in diagnosis, and not infrequently disseminated sclerosis has been diagnosed as cerebral tumor because of the presence of swollen disks with hemorrhages. In 1914 I wrote

4. Paton, Leslie: Proc. Roy. Soc. Med. (Sect. Ophth.) **16**:27, 1923.

a paper on this subject [5] in which I gave four main differentiating points:

1. The loss of sight precedes the ophthalmoscopic changes.

2. The ophthalmoscopic changes are of very brief duration.

3. The disks may show no trace of change after the swelling has subsided.

4. The recovery of vision is usually synchronous with the subsidence of the swelling.

While it is true that the disk may show little trace when the swelling subsides, later on the whiteness of the disk may be extreme. During the International Congress of Ophthalmology of 1913 in London I remember showing many of the distinguished visitors a case in which the disks were absolutely opaque white, yet vision was 6/5 in each eye and the visual fields were full. Careful perimetric examination in such cases, however, often shows small patches of relative scotoma paracentrally. They are usually close to the fixation point, and it requires very careful scotometry to discover them. So much has been written and said about the ophthalmologic signs of disseminated sclerosis that I shall not spend any more time on it now.

I have already spoken of my only case of acute disseminated encephalitis which, as I have said, followed, if it did not result from, an acute attack of chickenpox.

The cases in the acute ascending myelitis group are so dramatic in their incidence and their clinical course that, whatever the nature of the infection is, they merit a place by themselves. Gilbert Beck [6] gives a very full description with the report of the postmortem examination of a case which I had under observation at Queen Square. In this case there was a first attack with recovery, then a recurrence a year later, when the girl died.

I did not see her at the time of the first attack, and it was only on the recurrence a year later that I saw the disks. At that time they were dead-white with clearcut edges and showed little evidence of a preexisting neuritis. Vision in the left eye was equal only to perception of hand movements, and that in the right eye, to reading large letters at 1 yard (about 91 cm.) and there were large central scotomas.

I have been fortunate in being able to keep in touch with two cases which I saw when the condition was acute and in which the recovery has been as seemingly complete as the onset was dramatic. The picture presented is that of a rapidly developing blindness, beginning as a central scotoma and gradually spreading into the peripheral fields until

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5. Paton Leslie: Tr. Ophth. Soc. U. Kingdom **34**:252, 1914.

6. Beck, Gilbert M.: Brain **50**:687 (Oct.) 1927.

vision is completely lost; there are the characteristic pupillary reactions, the slight but definite papillitis and associated with that a rapidly ascending myelitis until the patient lies like a log and life is maintained only because the phrenic nerve is unaffected and so the diaphragm can act and maintain breath in the body. The possibility of recovery is so

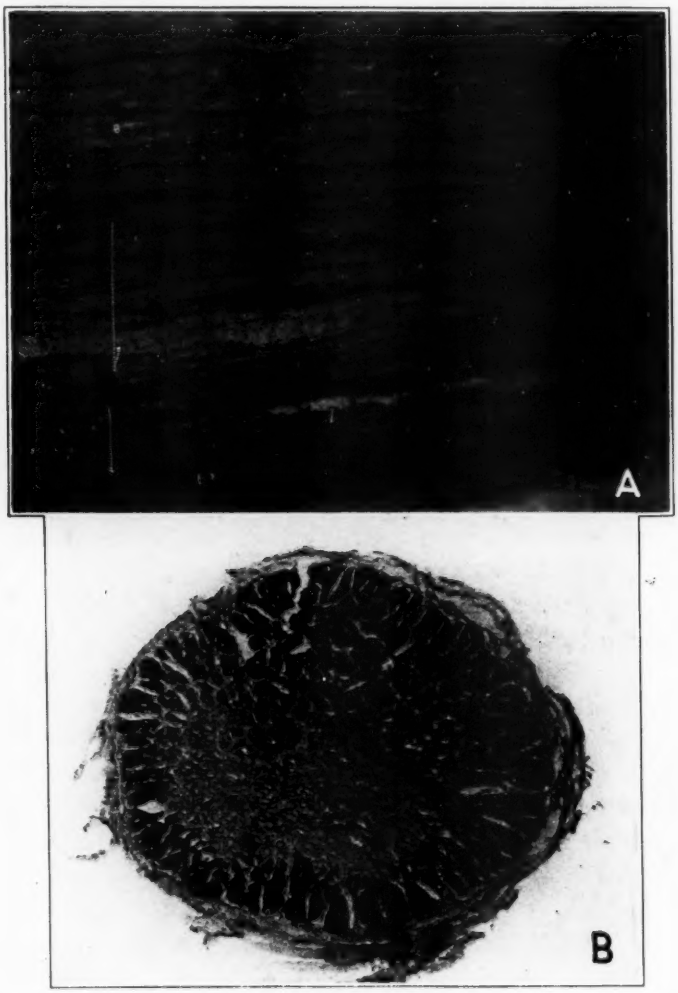

Fig. 10.—*A*, longitudinal section of the optic nerve in a recent case of neuromyelitis optica (Devic's disease), showing demyelination of the fibers; *B*, a cross-section of the optic nerve in a case four years after the occurrence of the inflammation, showing a large patch of demyelinated fibers. There was a large central scotoma during life.

complete that except for a whiteness of the optic disks it is almost impossible to say that anything has ever been wrong. One of the patients was the Sister in charge of the isolation ward at St. Mary's.

The spinal cord was affected up to the level of the neck, all the intercostal muscles were paralyzed, and she lived only because the phrenic nerve was unaffected. She was completely blind and had a small degree of swelling in both disks. That is many years ago. She is now alive and well, is married and has three children, and has led an active life.

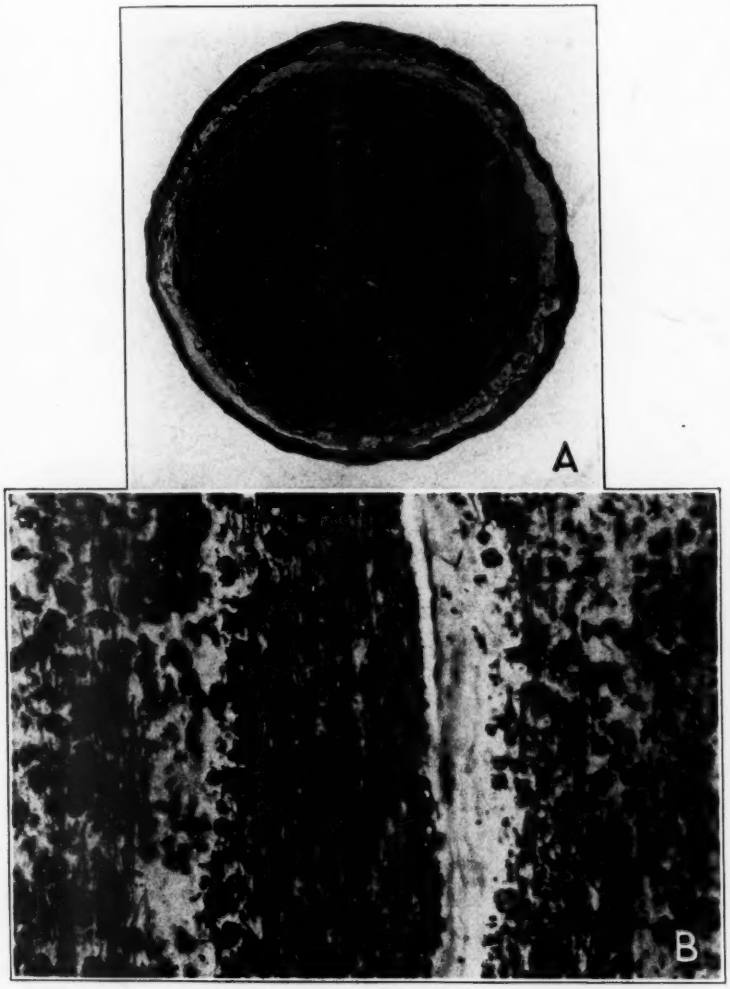

Fig. 11.—*A*, cross-section of the optic nerve in a case of diffuse periaxial encephalitis (Schilder's disease); *B*, longitudinal section of a nerve in the same case, showing the breaking up and loss of the myelin sheaths.

In the other patient under my care in 1910 the optic neuritis was associated with a higher degree of swelling of a hemorrhagic character, but again the recovery has been complete and lasting.

Beck gives his grounds for differentiating such cases pathologically from those of acute disseminated sclerosis as I certainly should be

inclined to differentiate them clinically, and he inclines to associate the condition more closely with Schilder's disease.

Of all these degenerating forms of optic neuritis I think Schilder's disease, or encephalitis periaxialis diffusa, must be recognized as a distinct entity. While the boundaries between most of the other forms of demyelinating disease are obscure and doubtful, and while it is open to argument that they are all only variants of disseminated sclerosis, differing only in the severity or extent of attack, Schilder's disease, both clinically and pathologically, can be distinguished. Rather more

Fig. 12.—Area of degeneration in the centrum ovale (occipital lobe) abutting on the visual cortex in a case of diffuse periaxial encephalitis (Schilder's disease).

than one third of the cases show optic neuritis. In others there are disturbances of vision without any evidence of optic neuritis, and that is not a matter for surprise when one realizes that the essential lesion is a degeneration of the white matter in the centrum ovale and most frequently seen in its most developed form in the occipital lobes. The case of which I have a record was peculiar in the rapidity of its course.

The patient was a widow, aged 43. She was stated to be well on the morning of June 10, 1925. In the afternoon the sight of the right eye was affected. On the morning of June 12 she was nearly blind in both eyes, and in the afternoon she was admitted to the National Hospital for Nervous Diseases under Dr. Grainger

Stewart. On June 13, with the right eye, she could distinguish hand movements only, and vision in the left eye was 6/60. There were no fundus changes visible. On June 15 she was completely blind. My examination that day showed that both disks were hyperemic, with blurring of the edges and a swelling of approximately 1 diopter. The veins in the lower half of the retina in both eyes were considerably distended. The condition was true optic neuritis with papillitis, not papilledema. She died on June 18. Examination post mortem showed that the most important lesions were the large patches of degeneration in the white matter of the occipital lobe surrounding the cap of the calcarine fissure. This degeneration probably played the most important part in the visual disturbance, but the complete absence of any reaction of the pupil to light in the latter days of life showed that the optic neuritis had also interfered with nerve conduction.

A very full review of these demyelinating diseases has been made by Milton L. Berliner.[7]

Another class of virus diseases attacking the central nervous system which also is of interest to ophthalmologists is that of which epidemic encephalitis is the prototype. It seems, however, as a rule not to be associated with either papilledema or optic neuritis, though ophthalmoplegic complications are characteristic. I have no experience of the Japanese variety or of the variety that was observed in the St. Louis epidemic, but I believe I saw almost the first case of the 1917 epidemic that occurred in England. I believe that sporadic cases had occurred for years before this and were ascribed to other causes, such as botulism, lead poisoning or alcoholism. I have really no excuse for dwelling further on this subject, but from the point of view of historic interest I should like to refer to a case simply because it is mentioned in the last paper published by Hughlings Jackson, in the writing of which I had the honor to be associated with him.[8] In that paper we spoke of the case as one of polioencephalitis superior haemorrhagica of Wernicke, but even at that time we were in doubt as to the diagnosis, as there was no history of alcoholism. My subsequent experience with encephalitis has led me to believe that we really were dealing with an early sporadic case of the von Economo type.

COMMENT

Throughout the whole of this lecture I have been definitely egotistical. I have not been writing a general review of the subject. I have been giving only a retrospect of parts of a huge subject which have come specially under my notice, points which have specially interested me in the last generation of thirty-three years. How different it

7. Berliner, Milton L.: Acute Optic Neuritis in Demyelinating Diseases of the Nervous System, Arch. Ophth. **13**:83 (Jan.) 1935.

8. Jackson, J. Hughlings, and Paton, L.: Lancet **1**:900, 1909. Taylor, J.: Selected Writings of John Hughlings Jackson, London, Hodder & Stoughton, Ltd., 1932, vol. 2, p. 439.

may all seem to the new generation who will review it in another thirty-three years, as different as the atom of Einstein and Niels Bohr and Eddington is from the atom of Kelvin and Clerk Maxwell. Ophthalmologists of the younger generation will have all sorts of resources of new knowledge to apply to the solution of these problems, and to some it will be given to arrive at a generalization and a simplification that will clear up much which is, at present, obscure and doubtful.

THE NERVE SUPPLY TO THE ORBICULARIS MUSCLE AND THE PHYSIOLOGY OF MOVEMENTS OF THE UPPER EYELID

WITH PARTICULAR REFERENCE TO THE PSEUDO-GRAEFE PHENOMENON

MORRIS B. BENDER, M.D.* [1]

NEW YORK

The downward rotation of the eyeball is normally associated with a corresponding movement of the upper eyelid. When an attempt is made to look downward with the eyes closed, the lids open slightly and assume the position normally taken in downward gaze. Defective central or peripheral innervation of the orbicularis palpebrarum, levator palpebrae or Müller's muscles may alter the movements of the upper lid. In discussing the impaired actions of the palpebrae, only lesions of the peripheral portions of the third and seventh cranial nerves will be considered. An unusual example of abnormal associated movements of an upper eyelid is found in the following case [1]:

REPORT OF A CASE

A 20 year old telephone operator was admitted to the Mount Sinai Hospital in February 1934 complaining of drooping of the left eyelid, double vision and headache. She had been in good health until nine months before admission, when a severe cold in the head developed, with redness and swelling around the left eye. These symptoms persisted for a few days and were soon followed by drooping of the left eyelid and difficulty in opening it. At the same time she complained of mild pains in the left supra-orbital and temporal regions. These recurred daily and lasted from one to three hours, during which time the eyes "felt heavy." A few weeks later she noted impairment of vision in the left eye. In spite of the persistence of these symptoms she continued to work. Three weeks before admission she began to see double on looking to the left and about the same time became aware of nausea and dizziness with radical changes in the position of her body. She finally had to give up her work because of the progressive nature of the complaints and was admitted to the hospital for study and treatment.

The physical examination showed no evidence of disease of any of the internal organs. There was some thinning of the hair of the scalp, and there was tenderness to percussion in the left frontotemporal region.

Read at the meeting of the New York Neurological Society, April 2, 1935.

From the Neurological Service of Dr. Israel Strauss, Mount Sinai Hospital.

*Recipient of the Dr. Isador Abrahamson Fellowship in Neuropsychiatry.

1. This case was reported in full detail by J. M. Levitt (Unilateral Ophthalmoplegia Totalis; Parasellar Osteochondroma: Report of a Case, Arch. Ophth. **12**:877 [Dec.] 1934).

The neurologic status was negative except for the following: incomplete left ptosis; pareses of all the extra-ocular muscles on the left side; very sluggish response of the left pupil to light and in accommodation; impairment of the right pupil to left consensual response; visual acuity of 20/30 in the left eye and 20/20 in the right. The peripheral, central and color fields were normal in both eyes. Examniation of the fundus revealed no obvious pathologic condition of the optic nerve, retinal vessels, choroid or retina in either eye.

Lumbar puncture yielded a clear colorless fluid under an initial pressure of 120 mm. of water. The total protein was 51 mg. per hundred cubic centimeters. The Wassermann reactions of the blood and spinal fluid were normal.

A roentgenogram of the skull revealed a shadow which was interpreted as a calcification in a tumor located to the left of the sella turcica near the posterior clinoid processes. The outline of the whole of the sella turcica was not clear.

Eight days after admission, a left frontotemporal craniotomy was performed, and a calcified tumor extending laterally from the sphenoidal ridge to the sella turcica was partially removed. The histopathologic diagnosis was osteochondroma. The postoperative course was uneventful. Three weeks after the craniotomy slight improvement in the muscle actions of the left eye was noted.

Fig. 1.—The patient three months after removal of an osteochondroma exerting pressure on the oculomotor nerve: *A* shows slight narrowing of the left palpebral fissure and slight enophthalmos; *B*, voluntary closure of the lids; *C*, lag in the upper left eyelid and slight inversion of the left eye on attempting to look down; *D*, slight inturning of the left eye on looking upward.

Examination of the left eye three months later revealed the following signs:

1. There were paralyses of the superior and inferior recti and oblique muscles and slight weakness of the external rectus.

2. The pupil was in middilatation and fixed to direct and consensual light stimuli, to accommodation and to reflex sympathetic and cocaine stimulations.

3. There was no ptosis, although the left palpebral aperture was slightly smaller than the right. There was slight enophthalmos (fig. 1 *A*). The superior lid appeared atrophic in its tarsal portion. The superior palpebral fold was prominent.

4. She was able to close the eyelids at will with equal force on both sides (fig. 1 *B*). On looking down, however, the left upper eyelid remained behind while the left eyeball turned slightly inward (fig. 1 *C*). In attempting to look down with both eyes closed, the left eyelid snapped upward and assumed the same abnormal position as in downward gaze; on looking up, both eyelids were equally retracted, and the left eyeball turned slightly inward (fig. 1 *D*). There was no change in

the size of the palpebral opening in looking to right or to left, nor was there any difference following the local application of cocaine to the left eye. The diameter of the pupil was not altered during any of the ocular movements. Direct and consensual corneal reflexes were elicited bilaterally even when the left upper lid remained elevated during the act of looking down. Blinking movements in the left eye, which under normal conditions should be synchronous with those in the right, were frequently omitted. The latter abnormality was evident so long as the eyes remained open, the position of the globes having no effect on the deficiency of the blinking movements in the left eye. The right eyelid showed the normal associated position and movement.

COMMENT ON CASE

The absence of the associated movement of the upper eyelid on downward gaze, as illustrated in figure 1*C*, is known as the pseudo-Graefe phenomenon. This observation, also known as the Fuchs sign, was described by Fuchs [2] in 1893, although Gowers [3] had previously observed two examples of the sign in 1879, when he discussed the physiology of the eyelid movements. Similar groups of cases have been reported by Bielschowsky [4] and by Wilbrand and Behr.[5] There are numerous types of abnormal associated movements of the lids. Some of these Sinclair [6] classified as follows:

Series I: Cases in which certain movements of the lower jaw are associated with an upward movement of the eyelid.

Group 1: Cases of one-sided congenital ptosis in which the drooping eyelid is raised both when the mouth is opened (digastric?) and also when the jaw is directed to the opposite side (external pterygoid).

Group 2: Cases of one-sided congenital ptosis in which the drooping eyelid is raised when the jaw is depressed, but is not raised with lateral movements of the jaw.

Group 3: Cases of one-sided congenital ptosis in which the drooping eyelid is raised with lateral movements of the jaw (external pterygoid action) but not with the simple opening of the mouth (Marcus Gunn Phenomenon).

Group 4: Cases in which similar associated movements of one upper eyelid with movements of the lower jaw occur, but in which there is no ptosis.

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2. Fuchs, E.: Association von Lidbewegung mit seitlichen Bewegungen des Auges, Beitr. z. Augenh., 1893, no. 11, p. 12.

3. Gowers, W. R.: The Movements of the Eyelids, Med.-Chir. Tr., London **62**:429, 1879.

4. Bielschowsky, A., in von Graefe, A., and Saemisch, E. T.: Handbuch der gesamten Augenheilkunde, Leipzig, W. F. Engelmann, 1907, vol. 8, pt. 2, chap. 11, p. 202; Lectures on Motor Anomalies of the Eye: Paralysis of Individual Eye Muscles, Arch. Ophth. **13**:33 (Jan.) 1935.

5. Wilbrand, H., and Behr, C.: Lider, Tränensekretion, Trigeminus, Pupille, Akkomodation, Heterochromie, Sympathetikus, in Wilbrand, H., and Sänger, A.: Ergänzungsband der Neurologie des Auges, Weisbaden, J. F. Bergmann, 1927, pt. 1, p. 32.

6. Sinclair, W. W.: Abnormal Associated Movements of the Eyelids, Ophth. Rev. **14**:307, 1895.

Series II: Cases in which contraction of the levator palpebrae superioris is associated with contraction of the rectus internus.

Series III: Cases of paralysis or paresis of one external rectus in which movement inward of the affected eye is associated with contraction of the orbicularis muscle and retraction of the globe (all in children under nine, and date back to infancy).

The disturbances of the associated movements of the eyelid in our patient may be grouped in series II in Sinclair's classification, in group 1: cases in which the eyelid does not follow the eyeball on downward gaze and in which there is associated contraction of the internal rectus muscle; and cases in which, with eyes initially closed, an upper lid snaps upward when an attempt is made to look down. The latter abnormality, hitherto undescribed, is probably another form of the pseudo-Graefe phenomenon.

In contrast to the movements of the eyelid observed in the pseudo-Graefe phenomenon are the abnormal movements of the upper lid in paralysis of the facial nerve, to wit: When the patient looks downward the upper lids descend simultaneously with downward rotation of the eyeballs. If in this position the patient is requested to close the eyes, the upper lid on the affected side will rise notably above its former position.[7] Apparently, in lesions of the facial nerve the involuntary movements of the affected upper lid are the converse of those observed in disturbances of the oculomotor nerve. Table 1 correlates the foregoing data:

TABLE 1.—*Comparison of Abnormal Movements of the Upper Lid*

	Looking Down	Closing Eyes	Looking Down, Then Closing Eyes	Closing Eyes, Then Looking Down
In lesions of oculomotor nerve: ptosis followed later by pseudo-Graefe phenomenon	Does not move (pseudo-Graefe phenomenon)	Moves down	Moves down	Moves up
In lesions of facial nerve: facial paralysis	Moves down	Does not move	Moves up (levator sign)	Moves down

PHYSIOLOGY OF MOVEMENTS OF THE UPPER EYELID

A brief review of the physiology of eyelid movements is necessary before explanations for the pseudo-Graefe phenomenon are offered.

Closing of the lids is produced by contraction of the orbicularis oculi, which is innervated by the facial nerve. The levator palpebrae superioris, innervated by the oculomotor nerve, raises the upper lid and maintains it in elevation. The function of the palpebral involuntary muscle of Müller is to widen the fissure in the vertical direction. It is

7. Dupuy-Dutemps: Un phénomène palpébral constant dans la paralysie faciale periphérique, J. de neurol. **8**:409, 1903.

innervated by the sympathetic nervous system. Automatic and reflex blinking movements [8] are performed by contraction of individual parts of the orbicularis oculi. From the physiologic point of view, the orbicularis is arbitrarily divided into an orbital and a palpebral portion. The latter is also subdivided into septal and tarsal components. Each of the parts may function separately or synchronously. This is best illustrated by the following facts: (*a*) An eye-glass may be held in place by voluntary contraction of the orbital part, while the palpebral portion continues to moisten the surface of the globe by involuntary periodic contractions (blinking); (*b*) in gentle voluntary closure of the lids, the movement is confined to the palpebral part, whereas in the involuntary act of blinking there is contraction of the tarsal subdivision only. The palpebral fissure is kept open by the tonic action of the two reciprocally innervated muscles, the levator and the orbicularis palpebrarum, the action of the former predominating. The tone of the orbicularis palpebrarum, however, is stronger than that of its antagonist, the levator, so that in sleep the lid is lowered.

TABLE 2.—*Muscle Action Involved in Normal Associated Movements of the Eyelids*

	Looking		Closing	
	Down	Up	Gently	Forcibly
Orbicularis	0	—	+	+
Levator	—	+	—	—
Superior rectus	—	+	0	+
Inferior rectus	+	—	0	—

+ = contraction; — = relaxation; 0 = no action.

The upward and downward rotations of the globes are associated with involuntary movements of the lids, the latter being raised and lowered pari passu with the eyeballs. The various muscle actions involved in the normal associated movements of the lids are given in table 2 (after Gowers,[8] modified by Whitnall [9]).

The upper lid follows the movements of the eyeball much more closely than does the lower lid, the margin commonly being maintained in juxtaposition to the edge of the cornea. Gowers [8] stated that the descent of the lid on downward rotation of the globe is not due to the contraction of the orbicularis, because (*a*) the movement is unattended by wrinkling, which can be observed in slight contractions of the orbicularis, and (*b*) in Bell's palsy the lid follows the downward movement of the eyeball sometimes as accurately as in the normal person. He there-

8. Duke-Elder, W. S.: Textbook of Ophthalmology, St. Louis, C. V. Mosby Company, 1933, vol. 1, p. 634.

9. Whitnall, S. E.: The Anatomy of the Human Orbit and Accessory Organs of Vision, ed. 2, New York, Oxford University Press, 1932, p. 185

fore implied that the movement of the lid on downward gaze is due to a relaxation of the levator palpebrae aided by gravity and cohesion of the globe to the lid. However, Sewall [10] stated that neither gravity nor cohesion of the lid to the globe is a factor in the associated lid action on downward gaze. In support of his point of view he remarked that the involuntary lid movement in Bell's palsy occurs even when the subject is inverted with head upside down, thereby eliminating the factor of gravity; furthermore, in a person with a glass eye, the lid slides farther downward over the glass in spite of possible deterrent friction.

Gowers [3] also observed that in a case of double ptosis, probably central in origin, the patient, when requested to look upward, was able to raise the eyelids involuntarily almost as well as the normal person.

These clinical observations, as well as those of others (Beevor,[11] Carmichael and Critchley [12]), illustrate the principle that muscles may be paralyzed for voluntary movements while involuntary movements are retained. Comparable to the foregoing observations is Sherrington's [13] experiment in which, despite resection of the oculomotor and trochlear nerves with subsequent external strabismus, the eye moved conjugately to the midline when cortical centers were stimulated; the eyeball returned to its "primary position" by virtue of relaxation of the external rectus muscle, the action of the denervated internal rectus muscle being only apparent.

On the other hand, the lack of associated movement of the lid observed in the pseudo-Graefe phenomenon demonstrates the reverse principle; that is to say, in a peripheral nerve lesion there may be normal function for voluntary action with loss of involuntary movement.

The questions then arise: (1) Is the presence of the involuntary downward motion of the upper lid in Bell's palsy actually due to a relaxation of the levator muscle, and (2) is the the absence of involuntary motion of the lid in the pseudo-Graefe phenomenon consequently due to a failure of relaxation of the levator?

Regarding the first question, it appears that the involuntary action of the supposedly paralyzed orbicularis approximates the action of the normal to such a degree that relaxation of the levator alone could not

10. Sewall, S. E.: Decompression of Facial Nerve; Physiology of Seventh and Ninth Nerve and Movements of the Lids in Facial Paralysis, Arch. Otolaryng. 18:746 (Dec.) 1933.

11. Beevor, C. E.: The Croonian Lectures on Muscular Movements and Their Representation in the Central Nervous System, London, Adlard & Son, Ltd., 1904, p. 56.

12. Carmichael, E., and Critchley, M.: The Relation Between Eye Movements and Other Cranial Muscles, Brit. J. Ophth. 9:49, 1925.

13. Sherrington, C. S.: The Integrative Action of the Nervous System, New Haven, Conn., Yale University Press, 1923, p. 279.

produce such a movement. It is suggested that in Bell's palsy, as well as in the normal, the automatic downward motion of the upper lid on downward gaze takes place by a contraction of the orbicularis rather than by a relaxation of the levator, the nerve impulses to the orbicularis for this involuntary action coming through fibers coursing in the branch of the oculomotor nerve supplying the levator muscle (fig. 2). The descent of the upper lid on downward gaze could not be due to active impulses from the sympathetic nervous system, because stimulation of these fibers causes a contraction of Müller's muscle, thereby enlarging the palpebral aperture. The involuntary action of the orbicularis in looking down is due more probably to active impulses transmitted by the oculomotor nerve.

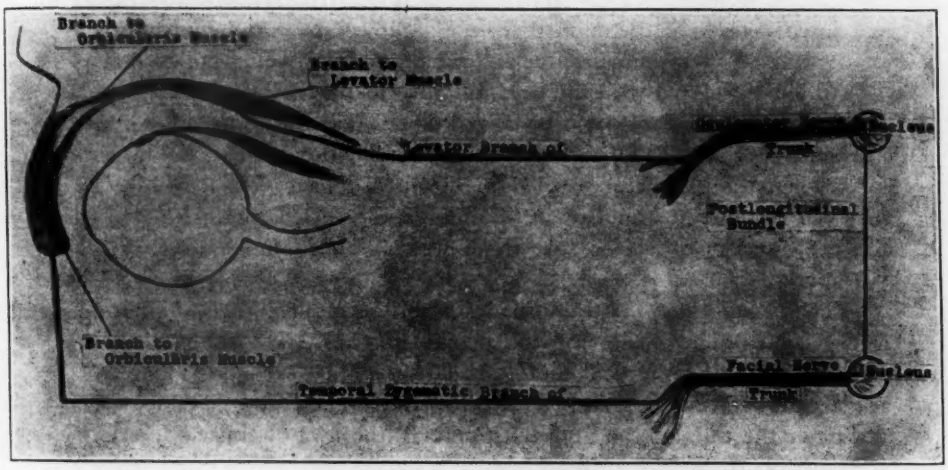

Fig. 2.—Drawing of a suggested innervation of the orbicularis by fibers coursing in the branch of the oculomotor nerve supplying the levator.

NERVE SUPPLY TO THE ORBICULARIS PALPEBRARUM

According to Mendel [14] the orbicularis is innervated by branches from the seventh cranial nerve as well as by fibers originating in the posterior portion of the third cranial nerve nucleus. Mendel's experiments were performed on rabbits, and conclusions were drawn from microscopic changes produced in the nuclei of the oculomotor nerve by a retrograde degeneration secondary to paralysis of the orbicularis and frontalis muscles. Harman,[15] who based his work on a morphologic study, denied Mendel's theory. Although it is not conclusively

14. Mendel, E.: On the Origin of the Upper (Ocular) Division of the Facial Nerve, Tr. Internat. M. Cong. **5**:311, 1887.

15. Harman, N. B.: The Innervation of the Orbicularis Palpebrarum Muscle, Tr. Ophth. Soc. U. Kingdom **23**:356, 1903.

demonstrated from the anatomic standpoint, there is much clinical evidence that the orbicularis receives nerve fibers from branches of the seventh as well as of the third cranial nerve. Jaboulay [16] referred to three cases in which excision of the parotid gland was followed by facial paralysis but without any disturbance of the movements of the lids. He implied that the action of the lids was effected through branches of the oculomotor nerve.

Relative to the second point, it seems that the absence of involuntary action on downward gaze is due not only to a failure of relaxation of the levator but, what is more important, to an increase in the tone of this muscle. The latter statement is illustrated by the following observations made in the patient described: (*a*) When the eyes are in the position of downward gaze and the affected lid is pulled down by external force, release of the applied force is followed by a snapping upward of the lid; (*b*) resistance can be felt while the lid is being pulled down; (*c*) in looking down with the eyes initially closed, the lid snaps upward. From these observations it may be postulated that in the pseudo-Graefe phenomenon the tonicity of the levator is greater than that of the orbicularis when the eyes are directed in downward gaze. It may also be inferred that nerve impulses were shunted to the levator instead of to the orbicularis; that is to say, there was a faulty innervation of the upper lid.

Fuchs [2] suggested that the pseudo-Graefe phenomenon resulted from faulty central innervation of the ocular muscles. He stated that in primary lesions of the oculomotor nuclei or lesions secondary to retrograde degeneration impulses meant for these nuclei would skip over and enter the cells of the nucleus supplying the levator muscle, thereby producing an unintended movement.

Bielschowsky [4] disagreed with the foregoing theory. Since many patients showed lesions in the peripheral portion of the nerve, he found it difficult to conceive of a complete retrograde nuclear degeneration sparing only the levator nucleus. He suggested that the phenomenon resulted from faulty peripheral nerve regeneration of the affected oculomotor nerve. This theory was inferred from Lipschitz' [17] explanation for the frequent presence of abnormal mass movements of the facial muscles in patients recovering from Bell's palsy. For example, when these patients were asked to close the eyes, other muscles innervated by the affected facial nerve would contract, producing unintended movements on that side.

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16. Jaboulay, quoted by de Paiva Meira, Sergio: Facial Palsy and Its Treatment by Nerve Anastomosis, Internat. Clin. **2**:241, 1921.

17. Lipschitz, R.: Beiträge zur Lehre von der Facialislähmung nebst Bemerkungen zur Frage der Nervenregeneration, Monatschr. f. Psychiat. u. Neurol. **20**: 84, 1906.

It has been shown by Ramón y Cajal [18] that in the repair of a damaged nerve the regenerating nerve fibers reach the peripheral stump in great disorder. The greatest number of sheaths, instead of receiving the outgrowths of the corresponding axons, are invaded by sprouts derived from axons in other regions of the central stump (fig. 3). Under such conditions, an impulse originally directed to one muscle will deviate to another and produce a contraction in the muscle for which it was not intended. Thus, in patients manifesting the pseudo-Graefe phenomenon, it is probable that the regenerated fibers of the third cranial nerve trunk innervate chiefly the levator palpebrae and internal rectus. For example, axons which were supposed to have reentered the nerve sheaths of the nerve bundle supplying the inferior rectus muscle have instead regenerated into the sheaths of nerves supplying the levator and internal rectus. Consequently, an impulse meant for the inferior rectus will be propagated to the levator and internal rectus, producing

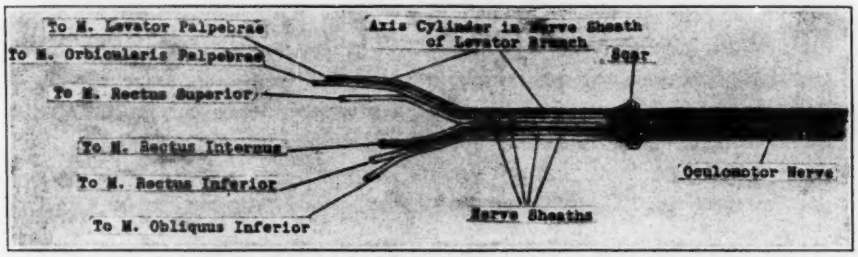

Fig. 3.—Drawing of the confusion that may arise in regeneration of injured nerve fibers. The sheaths, instead of receiving the outgrowths of the corresponding axons, are invaded by sprouts derived from axons in other regions of the central stump.

a slight contraction in these muscles. At the same time, the relaxation of the levator, which is supposed to be present when the eyelid moves downward, does not take place. It is also probable that fibers from the other bundles of the third cranial nerve enter the "regenerated pathways," producing the slight motion of the internal rectus on upward gaze.

Obviously, in lesions of the oculomotor nerve the function of the extra-ocular muscles other than the levator palpebrae would be impaired. However, a paralysis restricted to the levator muscle has been reported by Halpern [19] in a patient who was shot in the head, the bullet lodging

18. Ramón y Cajal, S.: Degeneration and Regeneration of the Nervous System, translated and edited by R. M. May, New York, Oxford University Press, 1928, vol. 1, pp. 276 and 361.

19. Halpern, L.: On the Pseudograefic Symptom: Casuistic Information, Harefuah (abstr. sect.) 8:111 (March-April) 1934.

in the base of the skull on the right side. This patient showed nothing more than a complete ptosis of the right eyelid for three months. At the end of this time, the ptosis gradually disappeared and the pseudo-Graefe sign appeared. Downward movement of the eyeball was intact. There was retraction on looking downward and inward, but seldom on looking only inward. The report of this case demonstrates that the pseudo-Graefe phenomenon may result from a lesion limited to the levator branch of the oculomotor nerve. Since there was no impairment of eyeball movements on downward gaze, there was no nerve damage and no reparative process in the branch to the inferior rectus. The only site where faulty nerve regeneration could have occurred was in the damaged levator branch. If, as suggested, the involuntary lid movement associated with downward gaze were due to an impulse transmitted to the orbicularis muscle by some of the fibers of the levator nerve (fig. 2), one might infer that the nerve impulse for the orbicularis was "shunted" to the levator muscle.

The hypothesis that the orbicularis muscle is innervated by the oculomotor and facial nerves is not new. The explanations set forth here for the pseudo-Graefe phenomenon not only strengthen such a theory but support the suggestion that the oculomotor nerve carries impulses to the orbicularis muscle for involuntary action by way of the levator nerve branch.

SUMMARY

1. A patient showing abnormal associated movements of an upper eyelid (pseudo-Graefe phenomenon) following compression of the oculomotor nerve by a tumor is described.

2. These movements are contrasted with the almost converse involuntary actions of the upper lid observed in Bell's palsy.

3. It is suggested that in Bell's palsy, as in the normal condition, the downward movement of the upper lid taking place on downward gaze is due to a contraction by parts of the orbicularis muscle. The nerve impulse to the orbicularis for this action may be transmitted by branches of the oculomotor nerve which also supply the levator muscle.

4. It is pointed out that the lack of associated movement of the upper lid on downward gaze (pseudo-Graefe phenomenon) is based on a tonic innervation of the levator muscle.

5. This tonic action is due to the faulty regeneration of nerve fibers which frequently occurs in the repair of injured peripheral nerves. Impulses meant for the orbicularis or for other muscles supplied by the oculomotor nerve are shunted to the levator muscle.

LOCAL QUININE THERAPY FOR SOME DISEASES OF THE CONJUNCTIVA AND CORNEA

ELIAS SELINGER, M.D
CHICAGO

Besides its action as a bactericide, astringent and mild anesthetic, the alkaloid quinine passes through the epithelium into the underlying tissues when applied locally to the mucous membrane. It is a protoplasmic poison which acts on the nutrition of almost all forms of protoplasm, at first augmenting and later depressing the activity of the protoplasm and finally causing the death of cells. Roth [1] and others showed that it destroys leukocytes and lymphocytes in and out of blood vessels. These properties explain the rationale of the treatment of certain diseases of the conjunctiva and cornea by the local application of quinine.

In two papers [2] dealing with the subject of local quinine therapy for trachoma, active interstitial keratitis and old corneal opacities, I reported that experiments on animals showed that the normal conjunctiva and cornea as well as the traumatized cornea show no ill effects from the daily application of quinine salts in various concentrations. Clinical experience with more than sixty patients, most of them treated for from several months to one year, also showed that the normal constituents of the conjunctiva and cornea do not suffer from the application once or twice a day of quinine bisulphate in the form of 2 per cent and 4 per cent ointment and of a 10 per cent solution of quinine bisulphate two or three times a week. The bisulphate was selected for use because next to the di-hydrochloride it is the most water-soluble salt of quinine and, being less acid, is less irritating than the di-hydrochloride.

TRACHOMA

Fifteen patients with trachoma in various stages of activity were treated in the dispensary for the treatment of the eyes of the Rush Medical College in the past year. The results were most gratifying. Subjective improvement was noted within a few days, and objective

From the Department of Ophthalmology of Rush Medical College, the University of Chicago.

1. Roth, G. B.: Action of Quinine on the Leucocytes, J. Pharmacol. & Exper. Therap. 4:157, 1912.

2. Selinger, Elias: Local Quinine Therapy in Cases of Interstitial Keratitis and Old Corneal Opacities, Arch. Ophth. 13:829 (May) 1935; Local Quinine Therapy in Trachoma, Am. J. Ophth. 18:631 (July) 1935.

improvement in the form of decrease in the hyperemia and papillary and follicular hypertrophy began to be evident after several weeks. In from four to six months most of the patients showed little or no evidence of papillary hypertrophy. The follicular changes, on the other hand, required from six to ten months or longer to disappear. Some patients seemed to respond more quickly to the treatment than others. Pannus, corneal infiltrates and ulcers of the cornea seemed to be favorably influenced by this treatment, and the formation of scar tissue seemed to be less than with other forms of treatment.

In addition to these patients, treatment with quinine bisulphate is being used, through the courtesy of Dr. H. S. Gradle, in a special group of twenty-five patients with very severe trachoma. These patients were selected as having the most severe and most resistant trachoma among a group of over four hundred patients with active trachoma under treatment in the clinics for the treatment of trachoma in southern Illinois. A detailed report on the results in this group of patients will be made in another communication by Dr. Gradle, Dr. Lenzen and myself.

Quinine seems to have a destructive action on the cellular infiltrates making up the trachomatous masses, while the normal constituents of the cornea and conjunctiva seem unaffected. Of special interest is the improvement in visual acuity as a result of the action of the drug on the corneal opacities. An improvement in vision was noted even in patients with old inactive changes of the cornea.

Method of Treatment.—The conjunctival sac is anesthetized by the instillation of a few drops of 0.5 per cent p-n-butylaminobenzoyl-dimethylaminoethanol hydrocloride, 1 per cent or 2 per cent butyn or some other suitable local anesthetic. The lid is then everted, and a 10 per cent aqueous solution of quinine bisulphate is applied to the palpebral and fornix conjunctivae with cotton wound applicators dipped freely in the solution. One applicator is used for the upper palpebral and upper fornix conjunctiva and another applicator for the lower fornix and lower palpebral conjunctiva of each eye, so that four applicators are used in cases of involvement of both eyes. The solution of quinine bisulphate is also applied to the plica semilunaris of each eye. The applications are made with a firm stroking or rolling movement until the surface turns a milky-bluish color. No precaution need be taken to keep the solution from coming in contact with the cornea. The cornea should, however, not be injured by rubbing the applicators over it. For this reason the patient should be directed to look down while the upper palpebral and the upper fornix conjunctiva are being treated and to look up while the solution is being applied to the lower fornix and the lower palpebral conjunctiva. Since a moderate amount of burning follows the treatment, cold compresses may be applied to the eyes for a few minutes after each treatment. The burning sensation

diminishes with subsequent treatment. This treatment in the office should be carried out two, or preferably three, times a week until most of the papillary and follicular hypertrophy have disappeared. The frequency of the treatment is then decreased, but the treatment should be continued once a week until all evidences of trachoma have disappeared and at two week intervals for another six months. In addition to this treatment, an ointment of quinine bisulphate prepared for use in ophthalmic practice is prescribed for use at home twice a day, just before the patient retires at night and in the morning. A 2 per cent ointment is prescribed first, but when this tube has been used and the patient has become accustomed to the burning sensation produced by the ointment, a 4 per cent ointment is prescribed twice a day. The use of the 4 per cent ointment should be continued for six months after all evidences of trachoma have disappeared.

Pannus, corneal ulcer and corneal infiltration require, in addition to the quinine therapy, treatment with atropine, hot dressings and dark glasses. Mechanical expression of the follicles speeds the rate of recovery, as in other forms of treatment of trachoma.

HYPERTROPHIC TYPES OF CONJUNCTIVITIS

There are forms of hypertrophic conjunctivitis which are as yet not definitely classified as to etiology and diagnosis but which in a general way are characterized by marked follicular hypertrophy of the fornix conjunctivae and resemble the conjunctivitis from caterpillar hairs and in some respects even trachoma. The form of treatment outlined for trachoma gave good results in one such case, as well as in several cases of folliculosis. The large, soft-looking follicular masses disappeared completely within a few months.

KERATITIS

Interstitial Keratitis.—In active interstitial keratitis the chief pathologic changes in the cornea consist in the more or less dense round cell infiltration into the middle and deep layers of the stroma and the invasion of the deep layers by newly formed blood vessels. It is generally agreed that antisyphilitic treatment has no influence on the progress of the keratitis. In fact, it is a frequent occurrence for the second eye to become inflamed while the patient is receiving antisyphilitic treatment. Atropine, hot compresses, dark glasses and other agents are of great value in preventing complications and in minimizing the sequelae but seem to have no effect on the course of the disease, which may last from two months to two years. The use of the 2 per cent ointment of quinine bisulphate twice a day in addition to the usual medication employed for interstitial keratitis gave excellent results in

six active cases of this disease. Within a few days the photophobia and blepharospasm decreased, the corneal infiltrates were seen to diminish in density and the visual acuity improved. In some cases one could see the older infiltrates disappear, while new ones, but not so dense, made their appearance. The duration of the disease also seemed definitely shortened, although it will require a larger series of cases to determine that point, since the course of the disease is so variable. The use of the ointment should be kept up from six months to a year or longer after all activity has ceased, in order to clear up as much of the resulting opacity as possible. The reason for this will be discussed under the heading "Old Corneal Opacities."

Disciform Keratitis.—In two cases of this chronic disease, characterized by deep central corneal infiltrates lasting for six months or longer, the condition showed a marked clearing of the infiltrates within a few weeks after treatment with the 2 per cent ointment twice a day was started.

Old Corneal Opacities.—This condition, resulting from interstitial keratitis, corneal ulcers and various forms of keratitis, improved strikingly with treatment twice a day with the 2 per cent ointment of quinine bisulphate. All the opacities had been present for periods varying from six months to five years and longer, and treatment with the quinine ointment was started only after medication with yellow mercuric oxide and ethylmorphine hydrochloride powder and subconjunctival injections of sodium iodide failed to improve the visual acuity or decrease the density of the opacities. Old corneal opacities, like other scars, undergo changes for a year or longer before they acquire a permanent character, but one is safe in assuming that marked changes occurring within a comparatively short time may be ascribed to medication, particularly if the changes in the opacities were very slight or absent before medication was begun. Since changes in the character and appearance of corneal opacities continue for a year or longer after their development, medication should be continued for at least that long, in order to secure a maximum clearing of the opacities. That is the reason for continuing the medication with quinine bisulphate in cases of interstitial and other forms of keratitis after all activity has ceased. In ten patients (seventeen eyes) with old corneal opacities the improvement varied from better perception of form to perception of as much as four lines on the Snellen distance test chart. Several patients showed an improvement in visual acuity from 0.1 to 0.3, one patient, from 0.4 to 0.8, and another, from 0.8 to 1.2. Most of the patients with trachoma who were under treatment also showed a definite improvement in visual acuity, but their cases cannot be included in the series of cases of old corneal opacities, as many of them had corneal changes in various stages of activity. In none

of the patients did the corneal opacities disappear entirely, but in most of them the opacities showed enough clearing to improve both the visual acuity and the cosmetic appearance.

Other Conditions.—In a few patients with superficial punctate keratitis and blepharoconjunctivitis and in one patient with episcleritis the condition responded much better to medication with quinine bisulphate than to other medication previously tried. This drug also proved itself of value in the treatment of acute and chronic conjunctivitis. In some of the cases in this last group the 2 per cent ophthalmic ointment was used, and in others a 1 per cent and 2 per cent aqueous solution of quinine bisulphate was prescribed twice or three times a day. A few patients with vernal catarrh were treated with quinine bisulphate in the manner outlined for trachoma. The patients were relieved of their subjective complaints but showed no changes in the objective findings.

One should remember that among the incompatibles and antagonists of quinine are copper, lead, zinc, mercury, iodides, bromides and their compounds, tannic acid, alkalis, ammonia and lime water. Among the synergists are arsenic, iron and mineral acids.

SUMMARY AND CONCLUSIONS

Locally, quinine is a bactericide and astringent and is slightly anesthetic to mucous membranes. It possesses the property of penetrating through mucous membranes when applied locally, and by its action as a protoplasmic poison it causes the destruction of leukocytes, lymphocytes and other cellular elements. It also inhibits the invasion of the tissues by these cells. These well known pharmacologic properties explain the favorable therapeutic action of quinine bisulphate in cases of trachoma, interstitial keratitis, old corneal opacities and a few other diseases of the conjunctiva and cornea.

55 East Washington Street.

TRANSITORY CHOKED DISK

REPORT OF A CASE WITH AN ELEVEN YEAR FOLLOW-UP STUDY

EMANUEL KRIMSKY, M.D.
BROOKLYN

I first saw the patient in the pediatric clinic of the New York Post-Graduate Hospital on Jan. 14, 1924. He was then a boy of 9 years and complained of vomiting spells of increasing frequency for two months. At the time of admission to the clinic they amounted to five or six attacks daily, and the vomiting was described as a "shooting out with much force" and as being preceded by splitting frontal and vertical headache, which was markedly relieved with the onset of the vomiting. The attacks were not related to meals and often awakened the child. He often felt dizzy during these two months but never fainted. He was absent from school for a great part of the time. At no time was he feverish or affected with impairment of vision. He had a discharge from both ears in 1922, but no aural disturbance since then. His father had been afflicted with frequent attacks of severe hemilateral headaches for twelve years. Neither he nor his mother was emotionally upset, and they cooperated well. Five brothers and sisters were well. However, four other children had died from unknown causes, and the mother had aborted four times.

Examination of the fundi at this time showed 3 diopters or 1 mm. swelling of each optic disk—a finding which was corroborated by both Dr. Martin Cohen and Dr. David Alperin. The edema appeared to be confined entirely to the disk areas, and the rest of the fundi were normal. The vision was normal, being 20/20 in each eye, and the visual fields were also normal.

This important finding brought the possibility of tumor of the brain to the fore but also made it necessary for my associates and me to exclude other plausible causes. The following conditions were tentatively listed: (1) tumor of the brain (including tuberculoma), (2) syphilis, (3) abscess of the brain, (4) periorbital infections (sphenoiditis and ethmoiditis), (5) hydrocephalus and (6) meningitis.

The supplementary studies sharpened our suspicions, and the results were summarized as follows:

Roentgen examination of the sella turcica and of the accessory nasal sinuses gave entirely negative results. Clinically, there was no discharge from the sinuses. Moreover, choked disk due to sinusitis is more apt to be unilateral, or markedly greater on one side, for the sphenoid sinuses are separated by a bony partition, which serves to localize the disturbance to the corresponding side.

Syphilis was ruled out, not by individual signs, such as a negative Wassermann reaction, but by the general clinical picture and by the

subsequent course of events. As was stated before, the repeated miscarriages made us cautious of excluding such a possibility.

The Pirquet and Mantoux tests were negative, but that does not necessarily exclude a diagnosis of tuberculoma.

The neurologic signs elicited and corroborated by Dr. Blakeslee of the neurologic staff, were summarized as follows: slight tilting of the head toward the left, lateral nystagmus toward the right, adiadokokinesis on the left, marked tache cérébrale and hyperactive deep and superficial reflexes. Otherwise, the results of the examination were completely negative.

Meningitis and hydrocephalus were excluded both clinically and by roentgen studies, although the patient would not grant permission for lumbar puncture.

Therefore, our original contention of tumor of the brain again came to the fore. In favor of this condition, the following symptoms and signs were noted: (1) splitting headaches; (2) projectile vomiting; (3) dizziness; (4) bilateral choked disk; (5) slight tilting of the head toward the left; (6) lateral nystagmus toward the right and (7) adiadokokinesis on the left side.

The neurologic picture seemed to point more to cerebellar involvement. Adiadokokinesis on the left side indicated involvement of the left side of the cerebellum and nystagmus toward the right, involvement of the right side of the cerebellum. Tilting of the head to the left is occasionally found in cases of cerebellar tumor on the corresponding side. In reviewing these signs, it appeared that we were probably dealing with a bilateral cerebellar lesion. As to the headache being frontal and vertical, no reliable deductions could be made, as there was no associated tenderness. Attacks of vertigo, of which the boy complained, are more apt to occur in cases of tumor of the posterior fossa.

Statistical studies regarding the localization of tumors of the brain further supported our contention, as shown by the following order of frequency: (*a*) children (under 20 years), (1) cerebellum, (2) pons and (3) crura cerebri; (*b*) adults, (1) cerebrum (65 per cent), and (2) cerebellum and pons (35 per cent).

As to the pathologic nature of these tumors, statistics showed the following order of frequency: (*a*) children, tuberculoma 55 per cent, glioma 15 per cent, sarcoma 12 per cent, cyst 10 and syphiloma; (*b*) adults, glioma 50 per cent, endothelioma, sarcoma and syphiloma.

How to account for the bilateral choked disk was the next problem. The most tenable assumption appeared to be that it was caused by mechanical pressure: (*a*) an enlarged and distended ventricle pressing on the optic chiasm or (*b*) increased cerebrospinal fluid pressure in the optic nerve sheaths. These two distinct and independent mechanical methods are represented diagrammatically in figures 1 and 2.

1. One theory explains the choked disk as a result of internal hydrocephalus. The foramina of Magendie and Luschka are below the levels of the medulla and cerebellum. An obstruction of these channels should produce a damming back of the fluid into the fourth ventricle, with resultant internal hydrocephalus. It also explains why a tumor of the cerebellum, distant from the optic nerve, may account for papilledema through the medium of a dilated fourth ventricle (dilatation of the infundibulum producing pressure on the optic chiasm and hypophysis, for example). That early papilledema is more frequent with a cerebellar neoplasm may be accounted for by the fact that the intraventricular space opposite the cerebellum is comparatively narrow. Still stated

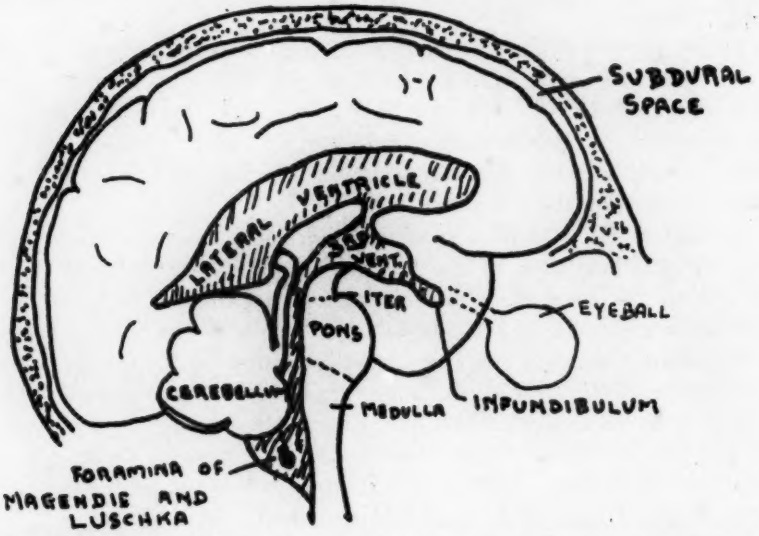

Fig. 1.—A diagram illustrating the first mechanical theory. (Modified from Still's "Diseases of Children.")

that "optic neuritis is almost never seen with congenital hydrocephalus, a curious fact throwing doubt upon the part played by pressure." Against this we may contend that the bones in infancy are very soft and pliable, thus allowing distention of the head without producing sufficient pressure on the optic nerve.

2. The other theory presupposes that the liquid in the subdural and subarachnoid spaces of the brain, when forced under pressure into the corresponding optic nerve sheaths, distends these spaces and compresses the central retinal artery and vein. The nerve head then becomes edematous; the retinal arteries are narrowed, and the veins are dilated.

By comparison of the two theories, it seems that the first theory offers a more logical basis for the interpretation of papilledema. It may

be that the fluid in the subarachnoid space has a much greater surface area to compress and that therefore the pressure per unit area would not be as great as in a corresponding internal hydrocephalus with less surface area. Also, the distribution of the fluid in the former (external) is more apt to be unequally distributed than in the latter.

The boy had been kept under careful and frequent observation. About three weeks after his first visit to the clinic, or about three months

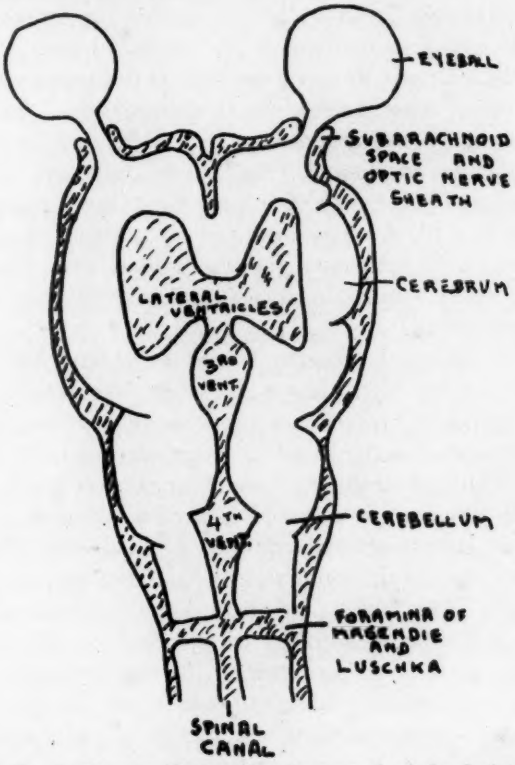

Fig. 2.—A diagram illustrating the second mechanical theory.

after the onset of his symptoms, he informed us that all his symptoms had suddenly disappeared and that he was perfectly well. His eye-grounds were again examined and were found to be normal. The explanation of this sudden recession was, of course, mere conjecture. I observed the patient regularly for eleven months (from January to November 1924), and he continued to feel well. Fortunately, I did not lose track of him thereafter, for he was repeatedly examined till recently by Dr. Alperin, who has kept me informed regarding his continued normal status. The vision is still 20/20 in each eye with a slight plus correction.

THE AQUEOUS

ITS GENERATION, FUNCTIONS AND CIRCULATION

HENRY SMITH, C.I.W., I.M.S. (RETIRED)
SIDCUP, ENGLAND

How is the aqueous produced? The original theory was that it was secreted by the glandlike epithelium of the ciliary body. This theory was based on the anatomic appearances and on the analogy of the action of such glandlike structures elsewhere in the organism. In natural history analogy is a powerful argument. In any field of human endeavor it is a powerful argument. One must recognize that nature loves uniformity and that in everything she does (not least in the physiologic field) she has an objective and has her method of reaching that objective. These are fundamental facts with which everything else must come into line. When nature's methods are discovered they are found to be transcendently grand.

The secretion theory, I presume, would never have been questioned had it not been for the high pressure in cases of glaucoma (up to 40, 50 or 60 mm. of mercury), whereas the pressure of the aqueous is 2 or 3 mm. lower than that of the blood in the capillaries in health. Hence, to explain the pressure in health no other theory is necessary. To explain the high tension observed in cases of glaucoma recourse is had to the theory of osmosis, according to which there is a semipermeable membrane consisting of the ciliary epithelium and its basement membrane. (A permeable membrane allows fluids and their dissolved contents to pass in both directions until the constitution of the fluid on the two sides of the membrane is equal or in equilibrium. A semipermeable membrane allows fluid and its dissolved contents to pass in one direction only. The process of making semipermeable membranes in the laboratory is rather complicated.)

Though osmosis is the fashionable theory of the present time to the total exclusion of the theory of a secretory function of the ciliary epithelium, it is based on pure assumption—the presence of a semipermeable membrane. This assumption implies that a method necessary to explain disease is the method of health—a large assumption I assume that it is generally accepted that the chief function of the aqueous is the nutrition of the lens and vitreous together with the mechanical function of maintaining the normal tension of the eyeball. The process of mere filtration or osmosis produces a fluid the composition of which is as

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constant as that of the blood, and as the process is nutritional, it would imply that cataract and glaucoma are not nutritional diseases. If these diseases are not nutritional, what are they? No one suggests that they do not have their origin in the aqueous. Thus the osmotic theory does not account for the occurrence of disease, yet cataract and glaucoma are clinical facts which on the basis of any theory must be accounted for. The secretory theory admits of explanation of disease of the lens and other structures dependent on the aqueous.

If one should assume that the function of the ciliary epithelium in health is analogous to that of the epithelium lining the renal tubules, I think one would not be far wrong. The cells of the renal tubules, as is generally recognized, are designed to keep the blood of the constant composition required for the nutrition of the body, and they have the power of absorbing most of the fluid which passes over them from the glomeruli (the glomeruli acting as mere filters) and of selecting the salts essential to health, i. e., potassium and sodium, and throwing them back into the circulating blood. At the same time, the cells may pass on such a diffusible salt as potassium iodide, as well as poisons, such as strychnine, and thus eliminate such deleterious substances from the body so rapidly that in case a huge dose of strychnine has been taken if the spasms are controlled with huge doses of chloral hydrate most of the strychnine and chloral will have been excreted in the urine in twenty-four hours and the patient will give thanks to the power of selection and rejection possessed by the epithelium of the renal tubules. These facts do not admit of question.

Is there any reason why the analogous ciliary epithelium in health should not possess such power of selection and rejection as that possessed by the epithelium of the renal tubules as well as a function of metabolism? If such functions are admitted as rational, there is in the eye a mechanism the function of which is to produce a pabulum requisite for the nutrition of the lens and vitreous in health and to maintain physiologic tension. In short, the ciliary epithelium has the function of maintaining the aqueous of the constant composition requisite for the physiologic nutrition of the structures which it nourishes, as the cells of the renal tubules have the function of keeping constant the blood of the composition required for the nutrition of the body in health. If the ciliary epithelium becomes diseased, it follows that the aqueous which it supplies will not be normal and hence the structures dependent on it will become diseased. When the cells lining the renal tubules become diseased temporary or permanent albuminuria occurs. When the cells of the islands of Langerhans become diseased diabetes occurs. When the cells of the liver become diseased a variety of pathologic conditions follow. Why should not analogous conditions result in the eye when the gland cells of the ciliary region become diseased?

It is known that in the early stage of cataract when distant vision has been reduced to 6/10 or 6/12 though no opacity is visible in the lens, the induction of intense hyperemia over the ciliary body for a fortnight or more leads to a renewal of the normal transparency of the lens in from three to four weeks with recovery of vision to 6/6 or 6/5 and such vision endures. I cannot understand this result unless the hyperemia reestablishes the physiologic function of the ciliary epithelium.

I have observed a considerable number of railway officials whose vision had to be examined annually after they reached the age of 45. My observations on which statistics are based were made chiefly on them, as they had to return periodically and were thus under control. I am aware that since I first wrote on this subject many eye drops and eye baths of various composition have been used and recommended as efficient by authors who devised them, while they were found by others to be of little use, so that many ophthalmologists have become skeptical. I stressed the issue that the results I obtained were due to the hyperemia which I induced and not to the agent I used. Those who wished to follow my lead stressed the importance of the drugs in their drops; hence their results are explainable on a different basis.

It is not known how local bloodletting or local hyperemia acts, but it is recognized that both do act. Any one who has observed a patient with acute hepatitis and has searched with a large trocar for an abscess and failed to find one, the result being the loss of from 20 to 30 ounces (591 to 887 cc.) of blood, has observed that the patient appeared well within twenty-four hours and perhaps thought that he had been operated on for an abscess. After the examination and loss of blood the gland cells recover their function with phenomenal quickness. A score or two of leeches applied over the liver in cases of acute hepatitis serve the same purpose. The use of eye drops such as I mentioned is analogous to the application of one sick leech in a case of acute hepatitis! What applies to cataract should, I believe, apply to acute or subacute glaucoma, the pressure being controlled by subconjunctival puncture into the aqueous chamber with a broad Graefe knife as often as necessary till physiologic equilibrium becomes reestablished through the action of the hyperemia on the ciliary epithelium.

NUTRITION OF THE LENS

I presume it is generally accepted that the nutrition of the lens is by osmosis or by osmosis tempered by the selective capacity of living tissue. I do not agree with the school which holds that nutrition and the functions of cells in general are a mere chemicophysical process. One does not know what life is. One does know, however, that the cells of the kidney function in a manner not explicable on any chemicophysical basis.

THE CIRCULATION OF THE AQUEOUS

At the annual meeting of this society in 1928 I read a paper of a speculative nature dealing with the circulation of the aqueous, but I could not go into detail as I had not as many facts as were necessary.

In that paper I speculated from the analogy of the rhythmic contractions of the uterus in pregnancy that the circulation of the aqueous was probably based on an analogous principle and suggested that some one who had facilities for vivisection should make a tracing of the pressure in the aqueous to see whether there was a special curve representing the opening and closing of the sluice gate of the Schlemm canal. The uterine sinuses become flooded with arterial blood which remains exposed to the limiting membrane between them and the placental sinuses for a sufficient time to permit the transfer of its elements of nutrition to the fetus and the taking over of the waste; after the exchange has been

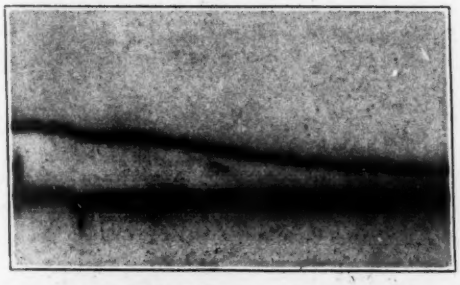

Fig. 1.—Curves showing physiologic circulation of the aqueous in an exsanguinated cat. The intra-ocular pressure was 26 mm. of mercury. The arrow indicates opening of the left femoral artery. (The tracing was made by Mr. Rycroft.)

completed the uterus contracts, driving the blood into the venous circulation, and then relaxes to admit a fresh charge. (The arterial pressure would of itself not be sufficient to drive the blood onward out of the vast sponge of uterine sinuses without these contractions of the uterus.) These periodic flushings are in the interest of economy. I speculated that similar periods of rest and flushing existed in the aqueous for similar reasons of economy and that the anatomic mechanism existed in the Schlemm canal with its operating valve.

I attended an interesting address by Mr. Rycroft at a meeting of the College of Surgeons a few months ago, during which, among other things, he showed tracings of the aqueous. His address, however, dealt with matter quite different from that presented in this paper, although allied to it. He has allowed me to use as many of those tracings as I thought fit. The tracing shown in figure 1 is from an animal which was being exsanguinated. That tracing is much better than if I had made it

myself, as I should merely have made a physiologic tracing. While demonstrating the physiologic requirement to which I have called attention, the tracing shows that the opening and closing of the valve are regular in time and are not dependent on pressure. It thus shows that the opening and closing of the sluice gate of the Schlemm canal are not operated by a pressure reflex. When one counts the arterial tracing and the marked and regular curve for the sluice gate beat, one finds that there are about twenty cardiac beats to one sluice gate beat, with about four of the latter beats to the minute. The tracing is a beautiful illustration of an ideal method of demonstrating the physiologic circulation of the aqueous. There is no mistaking the fact and the meaning of what I term the curve for the sluice gate beat on this tracing and its bearing on economy and nutrition, as in the case of the uterine contractions during pregnancy. If these contractions ceased the fetus would

Fig. 2.—Photomicrograph showing enlarged general view of the iridial angle: *a*, Schlemm's canal; *b*, trabecular tissue of pectinate ligament; *c*, scleral vein; *d*, dense scleral tissue; *e*, scleral process of spur projecting inward and forward from the sclera close behind Schlemm's canal; *f*, radial muscular fibers of the iris extending outward below the iridial angle; *g*, iridial angle; *h*, meridional fibers of the ciliary muscle; *i*, circular fibers of the ciliary muscle. The photomicrograph has been slightly touched up so as to emphasize the differentiation of tissue which is revealed by the Mallory stain. (The plate was made by Professor Thompson and reproduced with permission of the British Journal of Ophthalmology.)

die of lack of nutrition, including exchange of gases, and in the eye if the sluice gate ceased to function there would undoubtedly immediately be a nonphysiologic pabulum in the aqueous with all its consequences.

Professor Thompson's section demonstrates the anatomy of the circulatory mechanism better than any other I have seen. It shows the cross-section of the circumferential trench in the anterior portion of the sclerotic called the canal of Schlemm covered by the pectinate ligament through which the spaces of Fontana establish a communication between the aqueous chamber and the canal of Schlemm; this elastic

ligament is continued round the angle to the iris as the ligamentum pectinatum iridis. There are more spaces of Fontana through this ligament at the angle. The section shows the powerful anteroposterior band of the ciliary muscle attached anteriorly to the scleral spur or posterior lip of the canal of Schlemm. Thompson, when theorizing in his famous paper, called that band a pumplike mechanism. The action of a pump implies the pushing of the load, but muscular tissue functions by contracting, whereas to do this work as a pump it would have to do it by relaxing—an absurd supposition. The action of the muscular band is transparently a sluicelike mechanism. It was, and still is, believed that the pressure in the collecting venules of the Schlemm system is higher than that of the aqueous; hence the need for a pump. This pressure of the venules was never ascertained experimentally; it would be difficult if not impossible, to ascertain it. I presume that it was inferred from the capillary pressure in the hand or foot, which appears to be where physiologists have measured it when they referred to capillary pressure as being 22 mm. of mercury. It must be somewhat lower in the collecting venules in the hand or foot. The venous pressure everywhere below the neck is subject to hydrostatic pressure. When one considers that the venous pressure within the skull is drained by the internal jugular veins, in which the circulation is assisted by gravity and by the suction action of the thoracic movements to such a degree that if the internal jugular vein is wounded and the circulation stopped by pressure above the wound air is sucked in and the patient instantly dies, one can realize that the venous pressure is lower within the skull than anywhere else in the body. The ophthalmic vein is sheltered within the orbit and communicates directly with the cavernous sinus on its way to join the lateral sinus. Thus, instead of a pressure of 25 mm. of mercury in the collecting venules of the Schlemm canal, I doubt that the pressure in these venules is even 5 mm. of mercury. Thus the pressures are well adapted to a sluice system.

The muscle pulls back the scleral spur; the fluid rushes through the spaces of Fontana; the muscle then relaxes, and the elastic pectinate ligament adjusts the scleral spur as a valve.

Figure 1 shows that the opening and closing of the sluice occur once for every twenty beats of the heart, or about four times per minute.

I think I have shown that the circulation of the aqueous is about as perfect and as regular as the circulation of the blood itself. It leaves nothing to chance in health. It is the fashion to find various outlets, including the hyaloid canal and the sheath of the optic nerve, etc. As elsewhere in the body, one may find such subsidiary routes functioning in disease—as in cases of glaucoma; analogous subsidiary routes function in the case of hobnail liver, but they function imperfectly. In the eye in health they are not necessary, and, I presume, they do not function.

NEED FOR FURTHER EXAMINATION

There has been a liberal amount of chemical analysis of the aqueous of normal eyes extracted in life and after death, but absolutely no examination of the aqueous of diseased eyes extracted in life—data on aqueous obtained after death have no meaning. It is necessary as a foundation to an understanding of disease that the aqueous of diseased eyes be extensively analyzed. There is not the slightest risk to a patient with an early stage of cataract or with glaucoma in withdrawing a syringeful of aqueous, provided it is withdrawn slowly.

EFFECT OF BACTERIAL LYSATE ON STAPHYLOCOCCIC KERATOCONJUNCTIVITIS IN RABBITS

MAX M. STRUMIA, M.D.
AND
HUNTER W. SCARLETT, M.D.
PHILADELPHIA

Our purpose in this experimental work was twofold: first, to determine the effect of bacterial lysate on staphylococcic keratoconjunctivitis in rabbits and, second, more important, if an effect was obtained, to investigate which portion of the lysate was responsible for it.[1]

The work was suggested by the results obtained in the use of bacterial lysate in the treatment of six patients with chronic staphylococcic blepharoconjunctivitis and one patient with a corneal ulcer in each eye.

REPORT OF CASES

Miss S. C. was first seen on May 3, 1933. The eyelids had been crusted for six months, and the conjunctiva had been red and injected. Treatment with various standard preparations had no effect. An autogenous bacterial lysate from Staphylococcus aureus (nonhemolytic) and Staphylococcus albus was prepared on May 11 and used in an ointment of hydrous wool fat and petrolatum continuously until June 21. An improvement in the conjunctivitis was noted four days after the first application. When the patient was last examined, on June 21, the conjunctiva was white and the lids were not crusted.

Mrs. W. C., aged 40, was first seen on June 1, 1934. The conjunctiva had been red and injected, and there had been a slight amount of pus and crusting of the borders of the eyelids for three weeks. An autogenous bacterial lysate was prepared, and treatment was begun on June 1. An improvement was noted on the third day, and the patient was free from symptoms when last examined, on June 28.

Miss J. J., aged 14, was first seen on March 30, 1933. The conjunctiva had been red and the lids had been crusted for five years. Culture of pus from the eyes yielded a hemolytic strain of Staph. albus. An autogenous bacterial lysate was prepared and applied as an ointment. An improvement was noted in four days. The patient then stopped using the ointment for a month, and crusts reformed. She again started using the ointment, and in three weeks the lids were clear and the conjunctiva was not injected.

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From the Clinical Laboratory and the Ophthalmology Department of the Bryn Mawr Hospital.

1. In this paper the term bacterial lysate is used as synonymous with bacteriophage in order to avoid restrictions and implications on the nature of the lytic agent.

Mr. K. S., aged 27, was first seen on Dec. 2, 1933. He had had blepharoconjunctivitis with red, crusted borders of the eyelids for fifteen years. Various methods of treatment had been tried, including cauterization with silver nitrate. A culture of a hemolytic strain of Staph. aureus was obtained from the pus, and an autogenous bacterial lysate was prepared on December 7. Improvement was noted in one week. On April 10, 1934, the eyes were not inflamed, and no crusts were present. When the patient was last seen, on December 27, the eyes were entirely clear.

Miss S. C., aged 24, was first seen on May 18, 1934. She had had blepharoconjunctivitis for nine months. A culture of a hemolytic strain of Staph. aureus was obtained, and an autogenous bacterial lysate was prepared on May 25. Improvement was obtained two days after treatment with the lysate was commenced. One week later the eyes were white and clear.

Mrs. M. H., aged 37, was first seen on June 7, 1933. The eyelids had been red, crusted and stuck together for fifteen or twenty years. Culture of the pus revealed the presence of a hemolytic strain of Staph. aureus. An autogenous bacterial lysate was prepared and applied on June 12. Improvement was noted in four or five days. In three weeks the eyes were white and noncrusted, and no pus was present. She has been using lysate intermittently ever since. The lids are normal in appearance.

Mrs. M., aged 65 years, was admitted to the Bryn Mawr Hospital suffering with inflamed eyes and corneal ulceration in both eyes of fourteen days' duration. A hemolytic strain of Staph. aureus and streptococci were obtained by culture. A combined bacterial lysate was incorporated in an ointment of hydrous wool fat and petrolatum and applied to the eyes daily. Improvement was noted in two days. The eyes were white and the corneas were clear by the fifth day. There was no permanent corneal lesion.

EXPERIMENTAL STUDY

This clinical study was part of an organized effort of the members of the staff of the clinical laboratory and of the Bryn Mawr Hospital to determine as accurately as possible what effect could be expected from the use of bacterial lysates in various infections.

The culture used in this work was a hemolytic strain of Staph. aureus isolated on Oct. 16, 1933, from a recent hordeolum of one of the successfully treated patients. To 5 cc. of actively growing broth culture was added 1 cc. of stock multivalent staphylococcus lysate, and complete lysis was obtained. Thereafter the lysate was serially propagated at the expense of the same culture, progressively smaller doses being used. Usually from thirty-six to forty-eight hours was required for complete clearing. On April 25, 1934, a titration was made on the lysate of the tenth transfer, with the results shown in table 1.

In our work the eye was chosen as the experimental field particularly because of the ease with which the progression of lesions of the eye can be followed, because of the constancy of the lesions obtained with the technic to be outlined later, and because there is less likelihood of excessive concentration of substances which are known to interfere with the action of lysates in vivo, such as pus and exudates.

In a first series of four rabbits attempts to produce lesions of the conjunctiva and cornea by dropping a bouillon culture of the staphylococcus into the lower

culdesac failed. In the next series of four rabbits the cornea was scratched prior to the instillation of the staphylococcus culture, but no infection was produced. In the series of experiments here reported, about 0.05 cc. of an eighteen hour broth culture of the same strain of staphylococcus was injected into the cornea, a very fine needle being used. Within twenty-four hours the inoculated eye was shut tight with pus, and corneal infiltration had developed in all the animals. However, to obtain uniform and constant results it was found necessary to sensitize the animals prior to inoculation, using intradermal injections of 0.1 cc. of heat-killed staphylococci suspended in a solution of sodium chloride. This suspension contained 1 billion bacteria per cubic centimeter. Julianelle, Morris and Harrison [2] and Julianelle and Lamb [3] used the same technic in producing hypersensitiveness in the corneas of rabbits and monkeys. In our experience the simple repeated scarification of the cornea did not produce the desired effects.

In preliminary experiments the bacterial lysate was instilled in the rabbit's eyes in its original undiluted state, but that method of treatment showed no effect. It was later found, however, that incorporating the bacterial lysate in an ointment of hydrous wool fat and petrolatum, which remained in the eye, gave good

TABLE 1.—*Results Obtained with Lysate on Cultures of Staph. Aureus*

		Dates												
Tube	Lysate, Cc.	4/26	4/27	4/28	4/29	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8
1	0.0001	—	—	±	±	+++	+++	+++	+++	+++	+++	+++	+++	+++
2	0.00001	—	—	—	—	—	—	±	±	++	++	++	++	++
3	0.000001	—	—	—	—	+++	+++	+++	+++	+++	+++	+++	+++	+++
4	0.0000001	—	—	—	—	±	±	±	±	+	±	+	+	+
5	Solution of sodium chloride, 1 cc.	HG	HG	HG	HG	HG	HG	HG	HG	HG	HG	HG	HG	HG

— indicates no change; ±, doubtful clearing; +, slight clearing; ++, moderate clearing; +++, complete clearing, and HG, heavy growth.

therapeutic results. Accordingly, in the series of experiments here reported, lysate, heated lysate, filtrate and broth were incorporated always in an ointment of hydrous wool fat and petrolatum in the same proportion, namely, 15 per cent.

In what is usually indicated as bacteriophage or, better, bacterial lysate, there are at least four different main composing elements: (1) the lytic principle that was first described by Thwort [4] and by d'Herelle [5] and named bacteriophage; (2) the products of bacterial metabolism due to bacterial growth before lysis occurs, including disintegration of bacterial bodies; (3) the products due to the lysis of the bacterial bodies, and finally (4) the nutrient medium. Accordingly, any experiment dealing with the action of bacterial lysate should as nearly as possible study the effect of each of these elements. It is well known that it is not possible to obtain the lytic principle independent from bacteria and the medium in which they grow. It is, however, possible to destroy the lytic principle by

2. Julianelle, L. A.; Morris, M. C., and Harrison, R. W.: Am. J. Ophth. **16**:962 (Nov.) 1933.

3. Julianelle, L. A., and Lamb, Harvey D.: Am. J. Ophth. **17**:916 (Oct.) 1934.

4. Thwort, F. W.: Lancet **2**:1241, 1915.

5. d'Herelle, F.: Compt. rend. Acad. d. sc. **165**:373, 1917.

heating, thus affording a comparison between a lysate with the active lytic principle and a lysate without it.

The filtrate and lysate in the comparative experiment were produced by growing nutrient bouillon in a flask for a number of hours until the growth reached a concentration of about 100 million bacteria per cubic centimeter. The flask was then divided into two portions; to one homologous bacterial lysate with active lysin was added and to the other an equivalent amount of plain broth. The two flasks were then allowed to remain at room temperature until complete clearing of the bacteria had occurred in the flask containing the lysin. At the end of that period the contents of each flask were filtered through a Seitz filter and collected under sterile precautions.

EXPERIMENT 1.—The effect of the homologous bacterial lysate was controlled by employing the plain ointment as a base. Eight rabbits were used, all sensitized as previously noted. After the corneal inoculation the animals were not given any

TABLE 2.—*Results of Experiment 1* *

	Conjunctival Injection					Ciliary Injection					Presence of Pus					Lids Stuck Together					Corneal Infiltration					Hypopyon				
Rabbit†	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
226	S	M				S	M				S					S					S	M	M	M	M					
227	S	M				S	M				S					S					S	M	M	M	M					
228	S	M				S	M				S					S					S	M	M	M	M					
229	S	M				S	M				S					S					S	M	M	M	M					
230	S	M	M	M	M	S	S	M	M	M	S	S	S	M	M	S	S	S	M	M	S	S	S	M	M	M	M	M	M
231	S	S	M	M	M	S	S	M	M	M	S	S	S	M	M	S	S	S	M	M	S	S	S	M	M	M	M	M	M
232	S	S	M	M	M	S	S	M	M	M	S	S	S	M	M	S	S	S	M	M	S	S	S	M	M	M	M	M	M
233	S	S	M	M	M	S	S	M	M	M	S	S	S	M	M	S	S	S	M	M	S	S	S	M	M	M	M	M	M

* In all experiments all the animals were sensitized with homologous staphylococcus vaccine for three days prior to corneal inoculation. In this and the following table S indicates severe and M, mild. The five columns under each heading represent the number of days after the inoculation that observations were made.

† Rabbits 226, 227, 228 and 229 were treated with bacterial lysate in an ointment of hydrous wool fat and petrolatum. Rabbits 230, 231, 232 and 233 were treated with plain ointment of hydrous wool fat and petrolatum.

treatment for twenty-four hours. After that the condition of the eyes was noted, and the treatment was begun. This performance was repeated daily. Four animals were treated with an ointment containing lysate and four with the plain ointment of hydrous wool fat and petrolatum.

Table 1 shows the condition of the eyes of these animals for a period of five days. It will be readily noted that the animals treated with lysate showed an absence of pus, and the lids were open twenty-four hours after treatment, while the controls presented an abundant amount of pus in the conjunctival sac, and the lids were closed during the five days. The ciliary and conjunctival injection disappeared in the lysate-treated animals after forty-eight hours but remained in the controls during the total period of observation. Hypopyon appeared in the controls forty-eight hours after inoculation and remained thereafter. Two weeks after inoculation the rabbits treated with the plain ointment still showed evidence of infection and the conjunctiva was thickened, while the animals treated with lysate showed a normal conjunctiva. The corneal infiltration, although present in all the animals after several weeks, was less pronounced in the animals treated with lysate than in the control animals.

EXPERIMENT 2.—Seven animals were used, four of which were treated with the ointment containing lysate and three with the plain ointment. The results were practically the same as those obtained in experiment 1 and are summarized in table 3.

EXPERIMENT 3.—Five animals were used, two being treated with the ointment containing lysate and three with the plain ointment as controls. Of those treated with a plain ointment one died on the third day after having shown evidence of a severe ocular infection. On the fifth day after inoculation it was found that the ointment containing lysate was heavily contaminated. It will be noted that the effect of the lysate in this series was not as striking as it had been in the preceding

TABLE 3.—*Results of Experiment 2*

	Conjunctival Injection	Ciliary Injection	Presence of Pus	Lids Stuck Together	Corneal Infiltration	Hypopyon
Rabbit*	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
239	S M M	S M M	S	S	S M M M M	
240	S M M	S M M	S	S	S M M M M	
241	S M M	S M M	S	S	S M M M M	
242	S M M	S M M	S M M M	S	S M M M M	S M M M M
243	S S S M M	S S S M M	S S S M M	S S S S M	S S S S S	S S S S S
244	S S S M M	S S S M M	S S S M M	S S S S M	S S S S S	S S S S
245	S S S M M	S S S M M	S S S M M	S S S S M	S S S S S	S S S S

* Rabbits 239, 240, 241 and 242 were treated with an ointment containing bacterial lysate; rabbits 243, 244 and 245, with plain ointment.

TABLE 4.—*Results of Experiment 3*

	Conjunctival Injection	Ciliary Injection	Presence of Pus	Lids Stuck Together	Corneal Infiltration	Hypopyon
Rabbit*	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
255	S M M M M	S M M M M	S M S	S M S	S M M M M	
256	S M M M M	S M M M M	S M S	S M S	S M M M M	
257	S S S S S	S S S S S	S S M M M	S S S S S	S S S S S	
258	S S Died	S S Died	S S Died	S S Died	S S Died	Died
260	S S S S S	S S S S S	S S M M M	S S S S S	S S S S M	

* Rabbits 255 and 256 were treated with an ointment containing bacterial lysate, and rabbits 257, 258 and 260, with plain ointment.

series and that pus had returned in the eye of the lysate-treated animals on the fifth day. A new ointment was prepared with fresh lysate and applied daily to the eyes beginning on the sixth day after inoculation. On the ninth day after inoculation the eyes treated with the new ointment were healed except for slight corneal infiltration, whereas the animals treated with the plain ointment still showed signs of active infection.

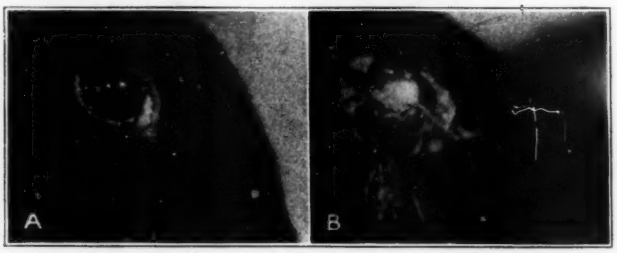
EXPERIMENT 4.—Eight animals were used. Four of them were treated with the ointment containing lysate, which had been heated at 60 C. for two hours. In vitro the experiments had proved on two occasions that this heated lysate no longer contained any active lytic principle or bacteriophage. Table 5 shows that the heated phage acted much the same as had the unheated phage in the previous experiments, whereas the untreated animals showed the usual severe and persistent infection. One of the control animals died on the second day

of staphylococcic pyemia. Pus in large quantities, sticking together of the lids, ciliary injection and conjunctival injection lasted in the animals treated with the plain ointment until the eighth day. All the animals showed slight permanent corneal infiltration, which was definitely more severe in the control animals.

TABLE 5.—*Results of Experiment 4*

	Conjunctival Injection	Ciliary Injection	Presence of Pus	Lids Stuck Together	Corneal Infiltration	Hypopyon
Rabbit*	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
276	S M M	S M	S M	S M	S M M M M	
277	S M M	S M	S M	S M	S M M M M	
278	S M M	S M	S M	S M	S M M M M	
279	S M M	S M	S M	S M	S M M M M	
281	S M M	S M	S M	S M	S M M M M	
282	S S S M M	S S S M M	S S S M M	S S S M M	S S S M M	
284	S S S M M	S S S M M	S S S M M	S S S M M	S S S M M	
285	S Died	S Died	S Died	S Died	S Died	

* Rabbits 276, 277, 278, 279 and 281 were treated with an ointment containing heated bacterial lysate, and rabbits 282, 284 and 285, with plain ointment.



A, rabbit 278 in experiment 4, four days after inoculation followed by treatment with an ointment containing heated bacterial lysate. *B*, rabbit 284, four days after inoculation followed by treatment with a plain ointment.

TABLE 6.—*Results of Experiment 5*

	Conjunctival Injection	Ciliary Injection	Presence of Pus	Lids Stuck Together	Corneal Infiltration	Hypopyon
Rabbit*	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
336	S M	S M	S M	S	M M M M M	
337	M M	M	M	M	M M M M M	
338	S M	S M	S M	S	M M M M M	M M
339	S M M M	S M M	S S	S M	M M M M M	M M M
340	S M M M	S M M	S S	S M	M M M M M	M M M
341	S M M M	S M M	S S	S M	M M M M M	M M M

* Rabbits 336, 337 and 338 were treated with an ointment containing bacterial lysate, and rabbits 339, 340 and 341, with an ointment containing bacterial filtrate.

EXPERIMENT 5.—The effect of bacterial lysate was compared with the effect of bacterial filtrate. Six animals were used, three being treated with bacterial lysate and three with bacterial filtrate. It will be noted from the table that although the effect obtained with the bacterial lysate appeared to be somewhat better than that obtained with the bacterial filtrate, the bacterial filtrate had a very distinct action, none of the animals having lesions with a course comparable with those

of the untreated controls of previous experiments. After the first day of treatment, the lysate-treated animals were free from ciliary injection and pus, while in the filtrate-treated animals both conditions persisted for two more days. Hypopyon appeared in one lysate-treated animal on the second day and lasted for two days; in all the filtrate-treated animals it appeared on the second day and remained for three days. Pus was absent in one lysate-treated animal on the second day and in the remaining two animals on the third day, while in all the filtrate-treated rabbits pus was present until the third day. The lids were open on the second day in the lysate-treated animals and on the third day in the filtrate-treated ones. In both series the animals showed a slight permanent corneal infiltration of uniform intensity.

EXPERIMENT 6.—This experiment was similar to the previous one, but in addition the effect of plain broth was studied. Six rabbits were used, two of which were treated with bacterial lysate, two with bacterial filtrate and two with broth. The animals treated with bacterial filtrate and bacterial lysate showed exactly the same behaviior, that is, definite rapid improvement. In those animals

TABLE 7.—*Results of Experiment 6*

	Conjunctival Injection	Ciliary Injection	Presence of Pus	Lids Stuck Together	Corneal Infiltration	Hypopyon
Rabbit*	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
148	S M	S M M	S	S	S M M M M	
149	S M	S M M	S	S	M M M M M	
150	S M	S M M	S	S	M M M M M	
151	S M	S M M	S	S	M M M M M	
152	S M M M	S M M M M	S	S	M M M M M	
153	S M M M	S M M M M	S	S	M M M M M	

* Rabbits 148 and 149 were treated with an ointment containing bacterial lysate; rabbits 150 and 151, with an ointment containing bacterial filtrate, and rabbits 152 and 153, with an ointment containing plain broth.

the pus disappeared on the second day and ciliary injection on the fourth day. The broth-treated animals showed pus until the third day and ciliary injection until the fourth day. In the two rabbits treated with broth healing was slower but was more rapid and complete than in the rabbits that had received only the plain ointment in previous experiments. All the animals showed a permanent slight corneal infiltration.

EXPERIMENT 7.—This was similar to experiment 6, but two more rabbits were added that were treated with a plain ointment of hydrous wool fat and petrolatum. From table 8 it will be seen that there was practically no difference between the behavior of the rabbits treated with lysate and those treated with filtrate. In both groups healing was more rapid than in the rabbits treated with broth. However, broth seems to show again a definite effect, as the rabbits treated with it did better than those that received the plain ointment. Only one lysate-treated rabbit was free from conjunctival injection on the fourth day, while the other, together with the filtrate-treated animals, showed slight conjunctival injection until the fifth day. Ciliary injection was absent in both sets on the fifth day. The presence of pus was noted for four days, being absent on the fifth in both the lysate-treated and the filtrate-treated animals. In these animals the lids were open on the fourth day. A slight hypopyon appeared in all the animals on the

second day and remained during that and the following day. All symptoms were present in the rabbits treated with broth and with a plain ointment of hydrous wool fat and petrolatum throughout the experiment, with the exception of hypopyon, which appeared on the second day and remained throughout the following day. However, the symptoms were more severe in the animals treated with the plain ointment than in those treated with broth. By the tenth day all the symptoms, with the exception of the corneal infiltration, had disappeared from all the eyes. The corneal infiltration remained as a slight permanent condition.

TABLE 8.—*Results of Experiment 7*

	Conjunctival Injection					Ciliary Injection					Presence of Pus					Lids Stuck Together					Corneal Infiltration					Hypopyon				
Rabbit*	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
365	S	S	M			S	S	M	M		S	S	M	M		S	S	M			M	M	M	M	M	M	M			
366	S	S	M	M		S	S	M	M		S	S	M	M		S	S	M			M	M	M	M	M	M	M			
367	S	S	M	M		S	S	M	M		S	S	M	M		S	S	M			M	M	M	M	M	M	M			
368	S	S	M	M		S	S	M	M		S	S	M	M		S	S	M			M	M	M	M	M	M	M			
369	S	S	M	M	M	S	S	M	M	M	S	S	M	M	M	S	S	M	M	M	M	M	M	M	M	M	M			
370	S	S	M	M	M	S	S	M	M	M	S	S	M	M	M	S	S	M	M	M	M	M	M	M	M	M	M			
371	S	S	M	M	M	S	S	S	S	M	S	S	S	S	M	S	S	S	S	M	M	M	M	M	M	M	M			
372	S	S	S	M	M	S	S	S	S	M	S	S	S	S	M	S	S	S	S	M	M	M	M	M	M	M	M			

* Rabbits 365 and 366 were treated with an ointment containing bacterial lysate; rabbits 367 and 368, with an ointment containing bacterial filtrate; rabbits 369 and 370, with an ointment containing plain broth, and rabbits 371 and 372, with plain ointment.

TABLE 9.—*Results of Experiment 8*

	Conjunctival Injection					Ciliary Injection					Presence of Pus					Lids Stuck Together					Corneal Infiltration					Hypopyon				
Rabbit*	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
376 OS	S	M				S	M				S					S					M	M	M	M	M					
378 OD	S	M				S	M	M	M		S					S					M	M	M	M	M					
379 OD	S	M				S	M	M	M		S					S					M	M	M	M	M					
377 OS	S	S	M	M		S	S	M	M	M	S	M	M			M					M	M	M	M	M					
378 OS	S	S	M	M		S	S	M	M	M	S	S	M			S	S				M	M	M	M	M					
379 OS	S	M	M	M		S	M	M	M	M	S	M	M			S					M	M	M	M	M					

* Rabbits 376 OS, 378 OD and 379 OD were treated with an ointment containing bacterial lysate, and rabbits 377 OS, 378 OS and 379 OS, with atropine.

EXPERIMENT 8.—Six eyes of four animals were inoculated. In this series the effect of the treatment with the lysate was compared with the effect of treatment with atropine. Three eyes were treated with a lysate ointment and three with a 1 per cent solution of atropine. Conjunctival injection disappeared from the lysate-treated eyes on the third day, while in the atropinized eyes it remained until the fifth day. Ciliary injection was absent in one of the lysate-treated eyes on the third day and in the other not until the fifth day. It was present in the eyes treated with atropine throughout the experiment. The lysate-treated eyes were free from pus on the second day, while the atropine-treated eyes contained pus until the fourth day. The lids of the animals in both sets were stuck together the first day, and one of the atropinized eyes remained glued together on the second day. After that all were open. There was slight corneal infiltration in all of the eyes as a permanent lesion, while hypopyon was absent from all. All other symptoms had disappeared by the eighth day.

EXPERIMENT 9.—This experiment was a résumé of the first seven experiments, the effects of lysate, heated lysate, filtrate, broth and plain ointment being compared. Two rabbits were treated with each of these substances in ointment form. Those treated with lysate, heated lysate and filtrate, respectively, showed practically identical results, healing very rapidly, while the broth-treated animals were slightly better than those treated with the plain ointment. The symptoms in the last two groups were much more severe and lasted longer than those in the first three groups. One of the rabbits treated with the plain ointment died of staphylococcic pyemia on the eighth day after inoculation. On the sixth day all the rabbits of the first three groups, with the exception of one treated with heated lysate, were symptomless, only a slight corneal infiltration remaining. The one rabbit also had the remnants of a hypopyon, which cleared up entirely by the eighth day. The animals in the last two groups, namely, the rabbits treated with broth

TABLE 10.—*Results of Experiment 0*

	Conjunctival Injection	Ciliary Injection	Presence of Pus	Lids Stuck Together	Corneal Infiltration	Hypopyon
Rabbit*	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
403	S M M M	S M M M	S M M	S M	S M M M M	S M M M
404	S M M M	S M M M	S M M	S	S M M M M	S M M M
405	S M M M	S M M M	S M M	S	S M M M M	S M M M
406	S M M M M	S M M M M	S M M	S	S M M M M	S M M M M
407	S M M M	S M M M	S M M	S	S M M M M	S M M M
408	S M M M	S M M M	S M M	S	S M M M M	S M M M
409	S S M M M	S S S M M	S S S M M	S S M M M	S S S M M	S S S S M
410	S S M M M	S S S M M	S S S M M	S S M M M	S S S M M	S S S S M
411	S S S S M	S S S S M	S S S S M	S S S M M	S S S M M	S S S S M
412	S S S S M	S S S S M	S S S S M	S S S M M	S S S M M	S S S S M

* Rabbits 403 and 404 were treated with an ointment containing bacterial lysate; rabbits 405 and 406, with an ointment containing bacterial lysate heated at 60 C. for one hour; rabbits 407 and 408, with an ointment containing bacterial filtrate; rabbits 409 and 410, with an ointment containing plain broth, and rabbits 411 and 412, with plain ointment

and those treated with the plain ointment, retained all symptoms through the ninth day, while the surviving animal treated with the plain ointment still had severe lesions on the eleventh day.

Comment.—On completion of the experimental work, on March 3, 1935, the activity of the bacterial lysate used throughout the experiment was tested. It was found that its potency had not diminished and that complete clearing of the broth cultures was obtained exactly as before.

After a review of the literature we feel that the results obtained in human beings and especially the results obtained in our experimental animals demonstrate that bacterial lysate is of benefit in the treatment of certain ocular infections when applied in the form of an ointment.

However, the interpretation of the modus operandi is a much more complex question. It has been generally accepted that to explain the action of lysate in vivo the simple phenomenon of bacterial lysis is inadequate. Our observation that a similar effect is obtained with lysate containing active lysin, lysate without active lysin and with bacterial

filtrates definitely proves the point. Bazy [6] in staphylococcic infections and Gratia and Doyle [7] in experimental septicemia due to the colon bacillus obtained similar results. The effect of the bacterial lysates and filtrates is probably due mostly to a process of immunization in response to the dissolved bacterial proteins, slight differences observed in some experiments in favor of the bacterial lysates being due probably to differences in concentration. Such a view is supported by results obtained by d'Herelle [8] in experiments in immunization by means of subcutaneous injections of a suspension of bacteriophage in cases of avian typhosis, barbone of the buffalo and infection of rabbits with Shiga bacilli; by Larkum [9] in antityphoid vaccination of human beings, and by Larkum and Corpron [10] in intravenous vaccination of rabbits with staphylococci; by Compton [11] and Flu [12] in subcutaneous inoculation of mice with plague bacteriophage; by Maslakowetz and Kasarnowsky [13] in inoculation of guinea-pigs with Shiga bacilli; by Arloing, Josserand and Nabonne [14] in immunization of rabbits intravenously against typhoid bacilli, and by Nobechi [15] in intraperitoneal immunization of guinea-pigs against cholera. It must be noted that the experiments by Arloing, Josserand and Nabonne were performed with bacterial lysates heated at 62 C. and therefore not containing bacteriophage or the lytic principle.

The claim made by d'Herelle that the immunization obtained in his experiments was exogenous and due to bacteriophage probably has no support of proofs and is not generally accepted.

The rapidity with which immunity develops after the administration of bacterial lysate is not surprising if one remembers that the bacterial lysates are water soluble and readily absorbed. Thus a rapid production of antibodies following the administration of bacterial lysate has been obtained by Larkum [16] and by Arnold and Weiss.[17] MacNeal, Frisbee

6. Bazy, L.: Compt. rend. Soc. de biol. **92**:485 (Feb. 27) 1925.

7. Gratia, A., and Doyle, D.: Compt. rend. Soc. de biol. **93**:452 (July 17) 1925.

8. d'Herelle, F.: The Bacteriophage and Its Behavior, Baltimore, Williams & Wilkins Company, 1920.

9. Larkum, N. W.: Am. J. Pub. Health **19**:31 (Jan.) 1929; J. Lab. & Clin. Med. **17**:675 (April) 1932.

10. Larkum, N. W., and Corpron, R.: J. Bact. **25**:77 (Jan.) 1933.

11. Compton, A.: J. Infect. Dis. **43**:448 (Nov.) 1928.

12. Flu, P. C.: Zentralbl. f. Bakt. (Abt. 1) **113**:468 (Aug. 31) 1929.

13. Maslakowetz, P., and Kasarnowsky, S.: Ztschr. f. Hyg. u. Infektionskr. **108**:13, 1927.

14. Arloing, F.; Josserand, A., and Nabonne, A.: Compt. rend. Soc. de biol. **104**:1246 (Sept. 20) 1930.

15. Nobechi, K.: Compt. rend. Soc. de biol. **95**:1250 (Nov. 26) 1926.

16. Larkum, N. W.: Am. J. Pub. Health **23**:1155 (Nov.) 1933.

17. Arnold, L., and Weiss, E.: J. Infect. Dis. **34**:317 (March) 1924.

and Slavkin [18] reported an increased phagocytosis of staphylococci by the reticulo-endothelial cells of the spleen and liver of rabbits two hours after the intravenous injection of bacteriophage.

In a series of unpublished experiments by one of us a very rapid production of antibodies was obtained in rabbits inoculated with heated bacterial lysates.

We do not wish to enter into a discussion of the question of specificity of action of bacterial lysates. Nonspecific therapeutic effects from bacteriophage have been noted by Brouardel [19] and others. Petersen's [20] work is an excellent review of the subject. In our experimental work a definite although slight healing action was obtained by the use of plain nutrient broth. Probably much more foreign protein stimulation would be obtained if the substance were injected. More interesting is the possible affinity of action of the bacterial lysates with the so-called Besredka [21] antivirus. Without discussing the presence of Besredka's hypothetic antivirus in bacterial lysates, it seems much more simple to explain tentatively the effect of both bacterial filtrates and bacterial lysates in our experiments on the basis of local absorption of bacterial proteins followed by immunization, probably both local and general. This view is expressed by Zinsser [22] and others. How much the production of avirulent dissociants as shown by Hadley [23] and the increase of leukocytosis and phagocytosis as shown by Smith,[24] Nelson,[25] Arnold and Weiss,[17] Gerards [26] and d'Herelle [8] had to do with the effects noted is not as yet entirely clear.

SUMMARY AND RESULTS

Staphylococcic keratoconjunctivitis was produced in sixty-two sensitized rabbits by intracorneal injection. The effect of the following substances was studied in nine thoroughly controlled series: (1) bacterial lysate containing active lysin (bacteriophage), (2) heated bacterial lysate not containing active lysin, (3) bacterial filtrate, (4) nutrient broth,

18. MacNeal, W. J.; Frisbee, F. C., and Slavkin, A. E.: Proc. Soc. Exper. Biol. & Med. **30**:12 (Oct.) 1932.

19. Brouardel: Bull. Acad. de méd., Paris **96**:24 (Nov. 16) 1926.

20. Petersen, W. F.: Protein Therapy and Nonspecific Resistance, New York, The Macmillan Company, 1922.

21. Besredka, A.: Local Immunization: Specific Dressings, Baltimore, Williams & Wilkins Company, 1927.

22. Zinsser, H.: Resistance to Infectious Disease, New York, The Macmillan Company, 1931.

23. Hadley, P.: J. Infect. Dis. **42**:263 (April) 1928.

24. Smith, G. H.: J. Immunol. **15**:125 (March) 1928.

25. Nelson, A. R.: J. Immunol. **15**:43 (Jan.) 1928.

26. Gerards, J. C.: Zentralbl. f. Bakt. (Abt. 1) **111**:493, 1929.

(5) plain ointment of hydrous wool fat and petrolatum used as a base for all substances and (6) atropine.

It was found (1) that the bacterial lysate, the heated bacterial lysate and the bacterial filtrate had almost the same effect, that is, each produced a rapid and complete healing of the ocular lesions; (2) that a slight effect was obtained from the plain broth, and (3) that the rabbits treated with the plain ointment constantly showed more severe ocular lesions, which lasted longer and produced more serious permanent damage (corneal infiltration) than was noted in the rabbits treated with some of the other substances.

The action of the bacterial lysate appears to be due not to the action of the lytic principle itself (bacteriophage) but to the dissolved bacterial proteins, probably through a process of local absorption followed by local and general immunity.

NOTES ON THE PATHOLOGY AND SURGICAL TREATMENT OF SYMPATHETIC OPHTHALMIA

BERNARD SAMUELS, M.D.
NEW YORK

The subject of the present paper is one of great practical importance because on the correct judgment of the surgeon, in cases of injury, the future vision of the patient may depend. It has been known for a long time that if one eye receives a perforating wound, occasionally the other eye, hitherto sound, may be affected by an inflammation of malignant nature leading to atrophy and blindness. Since no cause other than the injury of the first eye is found for the involvement of the second eye the disease has come to be called sympathetic ophthalmia. This disease does not occur when the wound in the injured eye heals correctly and when the function of the eye is not interfered with. It supervenes in the uninjured eye only when the first eye shows signs of iridocyclitis as a result of traumatism. From clinical observation it is known that not all eyes that suffer from traumatic iridocyclitis excite sympathetic ophthalmia. However, it is realized that the enucleation of the injured eye is the one certain means of insuring the safety of the other. If one observes, after a perforating wound, that the eye becomes soft and atrophic, that the cicatrix on the surface is retracted, that the eye is painful or sensitive to touch, and that the vision is failing, one finds in these symptoms an indication for enucleation, because such an eye has the potentiality of producing sympathetic ophthalmia. One cannot predict positively that it will do so, but it may.

HISTOLOGIC OBSERVATIONS IN THE EXCITING EYE

In the eye that has excited inflammation in the fellow eye there is found a peculiar and specific lesion that distinctly differs anatomically and in its consequences from that of the familiar traumatic endophthalmitis. If one places in a group eyeballs that have been removed for fear that they will produce sympathetic ophthalmia and if in another group one places those that have excited sympathetic ophthalmia and that have been excised in the hope of shortening or curing the disease, one finds in the latter group, in addition to the common feature

From the Department of Surgery, New York Hospital, and the Eno Laboratory, New York Eye and Ear Infirmary.

This paper is a summary of remarks made in a demonstration of anatomic preparations before the Section on Ophthalmology and Oto-Laryngology at the One Hundred and Twenty-Ninth Annual Meeting of the Medical Society of the State of New York in Albany, May 14, 1935.

of iridocyclitis, a characteristic infiltration in the choroid. In endophthalmitis one is not accustomed to see evidences of irritation in the choroid because this layer is protected by the retina from toxins originating in other structures. Sympathetic ophthalmia is preeminently an infiltration in the uveal tract, showing in a singular way no tendency to form exudates on the uveal surface. One must never forget that the infiltration in the ciliary body and iris is always combined with another disease, iridocyclitis, due directly to the perforation in this segment of the eyeball. As a result of the endophthalmitis, which precedes the infiltration, there are formed cyclitic membranes on the surfaces of the ciliary body and iris. One looks to the choroid to find the characteristic infiltration of sympathetic ophthalmia developed in its purest form since

Fig. 1.—One recognizes in this field in the choroid groups of epithelioid and giant cells (*eg*) scattered in a denser and darkly staining groundwork of lymphocytes.

the posterior half of the eye is seldom damaged by the injury, so that the infiltration there is not complicated by the presence of a separate disease.

The infiltration is composed chiefly of lymphocytes, which first appear in and around large veins, destroying their walls and invading and occluding their lumens. The focal accumulation of lymphocytes in the walls of the veins is a distinguishing point in sympathetic ophthalmia, even when epithelioid and giant cells are absent. Epithelioid cells, which are larger than lymphocytes, have an oval vesicular nucleus and a large amount of protoplasm staining with eosin. They are so called because they exactly correspond to the elements bearing the same name in tuberculosis. Where epithelioid cells appear in numbers they show a tendency to coalesce, the outlines disappearing so that the protoplasm

becomes confluent, and the whole is transformed into a giant cell. Nests of epithelioid cells are present in the midst of broad fields of lymphocytes, which often form septums between the nests. In some places the nests are round and in others elongated. In reality it appears that these groups are strands, and that it depends on the direction of the section whether they manifest themselves in round or drawn out islands. Epithelioid cells are thought to be derived from a proliferation of the cells in the walls of blood vessels, the early disappearance of which is typical of this disease. The division of the uvea that almost invariably shows the infiltration is the choroid, in the layer of large blood vessels. In the suprachoroidal lamellae, in the early stages, solely lymphocytes are found since there are no blood vessels to degenerate. The infiltration develops in the following stages:

1. Stage of lymphocytic infiltration in and around the walls of the large veins of the choroid.

2. Stage of formation of typical nodules containing giant cells in the center, surrounded by epithelioid cells and lymphocytes.

3. Stage of the formation of tumor-shaped masses of granulation tissue composed of the aforementioned cells. Tumor-like formations are more apt to be found in the iris than elsewhere, whereas the choroid undergoes a uniform thickening, which may be three or four times as great as the thickness of the original layer. In excessively developed cases the infiltration of the uveal tract may reach such proportions as to occupy almost the whole cavity of the eyeball, all of which may take place in the short space of a few weeks.

Singularly the choriocapillaris is free from infiltration. One will always notice a compressed pinkish streak on the internal surface of the choroid, under the pigmented epithelium, which contains none of the intensely stained lymphocytes seen in the deeper layers. The pigmented epithelium itself may present small moundlike projections on its surface—the so-called foci of Dalen—composed of cellular elements that have wandered through the lamina vitrea and of cells from the pigmented epithelium.

Having regard to the other divisions of the uveal tract, one finds that in the ciliary body the infiltration is confined to the vascular layer, a nodule in the muscle being a rare exception. No matter how dense and thick the infiltration in this layer may be, the unpigmented ciliary epithelium goes interruptedly over it, so that the infiltration may be said still to be confined to the uvea. When a search for giant cells is made they are more likely to be seen in the ciliary body than elsewhere. Here and there in the choroid giant cells containing stromal pigment are sometimes encountered; such cells, it is believed, originate from chromatophores.

In the iris the infiltration, no matter how exuberant, is covered on the corneal side by the compressed anterior limiting layer, which gives it a sharp outline. On the other hand, posteriorly, typical nodules break through the disintegrated pigmented epithelium and expand on the capsule of the lens, causing the posterior synechia associated with sympathetic ophthalmia. Giant cells in the infiltration of the posterior chamber may also contain pigment granules that apparently have escaped from the epithelium. The sphincter muscle, as in the case of the ciliary muscle, is often identified when all else of the stroma is replaced by the infiltration. The presence of plasma cells and eosinophils in connection with the characteristic lymphocytes, epithelioid cells and giant cells is sometimes mentioned in descriptions. These cells are in no way essential to the picture of sympathetic ophthalmia; rather they

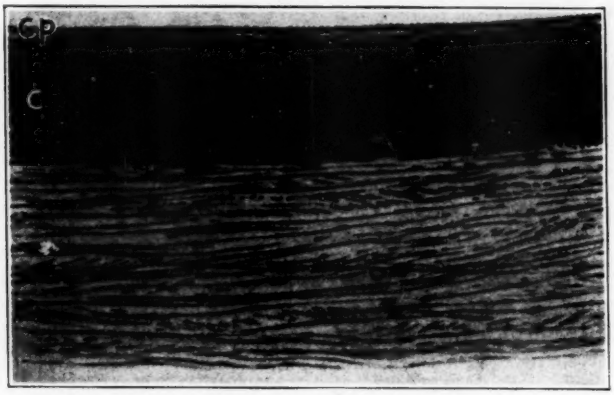


Fig. 2.—The choroid (*c*) is densely infiltrated with lymphocytes and is almost twice the normal thickness. The choriocapillaris (*cp*) is free from infiltration and on this account stands out as a light streak between the pigmented epithelium, which is intact, and the darkly staining stroma.

are an expression of an accompanying chronic iritis or cyclitis as a result of the injury.

Prolapsed portions of the uveal tract may reveal the most exuberant type of infiltration. Covered by the conjunctiva and having a grayish-blue color, such masses simulate staphylomatous areas at the seat of the wound. No detached tag of uveal tissue, wherever it may be, for instance strands of the perichoroidal lamellae clinging to the sclera when the choroid is separated, or ragged particles of uvea isolated on the surface of the eyeball near the wound, ever escapes the infiltration.

While bearing in mind that the uvea is the primary seat of the sympathetic ophthalmia, it is interesting to consider the manifestations of the disease in other structures of the eyeball. The sclera, having everywhere uveal tissue as the lining of its internal surface, is many

Fig. 3.—The perforating wound (*w*) is in the region of the ciliary body. The lens (*l*) is lying on the external surface of the eyeball. The choroid (*c*) was wrinkled before it became infiltrated. The infiltration extends into the chorio-capillaris and the sclera (*s*).

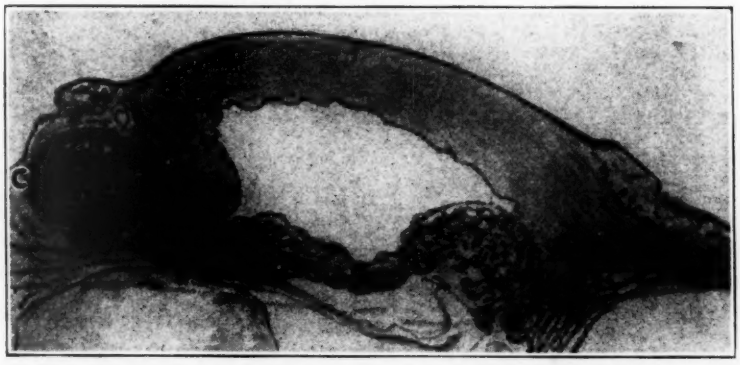


Fig. 4.—The incarcerated iris (*c*) has been converted into a tumor-like mass of granulation tissue, covered by conjunctiva. Clinically such a formation may resemble a staphyloma of the sclera.

times inflamed to a surprising extent, so much so that in severe cases one is justified in thinking of sympathetic ophthalmia as a chorioscleritis. Long stretches of the lamina fusca may be involved in an internal scleritis, files of lymphocytes separating the bundles. The infiltration appears along the extensions of the uveal tissue that line emissaria, within the lumens of which there may be giant cells, and often epithelioid cells are present ensheathing the vessels. Spreading on all sides from the walls of the emissaria, files of lymphocytes not infrequently appear in the middle layers of the sclera. Around the external openings of emissaria, sympathetic nodules may develop, in connection with which

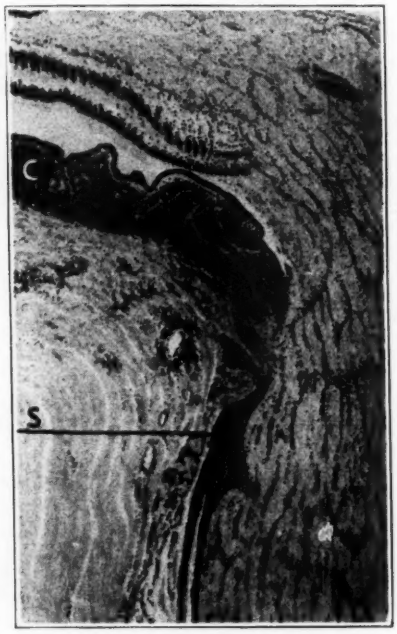


Fig. 5.—The specific infiltration reaches from the choroid (*c*) along emissaria into the sheaths (*s*) of the optic nerve.

the outer layer of sclera may show a lymphocytic infiltration—external scleritis. Typical nodules in the tissues of the intervaginal space and even in the substance of the nerve have been reported by A. Fuchs. Nodules have been identified between the fibers of the inferior oblique muscle, not only at its insertion in the sclera but also at points a considerable distance away. It is not possible to say to what extent the orbital tissues may be affected because evisceration is not performed in this disease, but from the frequent involvement of tags of tissue adhering to the eyeball one gleans that the specific infiltration may be more far reaching than hitherto suspected.

The narrow zone of the fibrous tissue just external to the limbus, where the tissue is relatively thin to accommodate the external and the internal sulcus, merits special description on account of its proximity to the root of the iris, which is a favorite spot for excessive development of the infiltration. Particularly when the angle of the chamber is filled with infiltration this narrow vascular zone of the sclera attracts attention in the sections because of its intensely blue stain, brought about by row after row of lymphocytes packed between the layers of connective tissue, splitting them, destroying them and producing a regular dehiscence. One remarks on this evidence of histolysis, and this is the only place that ever shows it in such definite relation to the specific infiltration.

In sympathetic ophthalmia the retina almost constantly presents a heavy infiltration in the walls of the blood vessels—called by Meller "sympathetic perivasculitis." A nodule in the retina is one of the rarest findings.

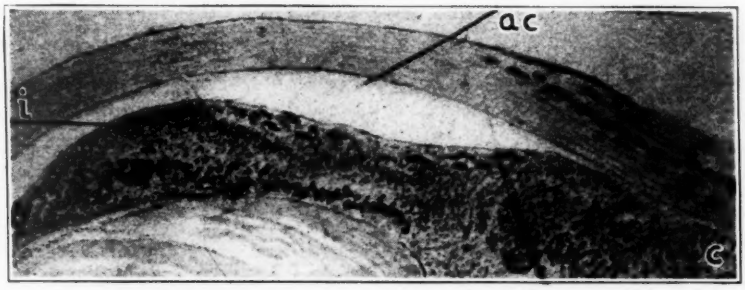


Fig. 6.—Notwithstanding the dense infiltration in the iris (*i*) and ciliary body (*c*), the anterior chamber (*ac*) is free from cells, and there are no precipitates on Descemet's membrane. Observe the sharp contour of the anterior limiting layer of the iris, which, pushed forward and seen through the clear cornea, might have been mistaken for iris bombé. The angle of the chamber is obliterated. An attempt to perform an iridectomy would have failed because the entire iris has been converted into granulation tissue.

The structure of the eyeball that is least affected is the cornea, which, in contradistinction to the sclera, is not in contact with uveal tissue but is far removed from it. The aqueous and Descemet's membrane seem to protect the stroma to a certain extent from whatever irritant substances go with sympathetic inflammation, or it may be that the corneal lamellae have a natural resistance.

OBSERVATIONS ON THE SYMPATHIZING EYE

In the sympathizing eye the infiltration is of exactly the same character as that in the exciting eye. One would not anticipate seeing membranes on the surface of the uveal tract in the sympathizing eye, because there has been no traumatic iridocyclitis to produce them. The

sympathizing eye is rarely examined, because there is no reason for removing it unless the patient dies from another malady or the eye causes so much pain that the patient prefers to have it excised. It is seldom that the injured eye preserves any vision, and when it does it is not enucleated because the sympathizing eye may become blind and then one would have sacrificed the last remnants of vision left to the patient.

Clinically the diagnosis of sympathetic ophthalmia can be made only from the symptoms in the uninjured eye. In the injured eye symptoms of traumatic iridocyclitis mask the picture and are sufficient to account for all the symptoms in the eye.

As a rule sympathetic inflammation supervenes within a few weeks after an injury. A little less than two weeks is given as the minimum time. Notwithstanding that the disease may break out many years after an injury, the infiltration itself always gives the impression of being recent. The examination of many eyeballs suggests that the infiltration flares up at almost the same time in all parts of the uvea and its extensions in the emissaria. However, the anterior infiltration is usually a little older than the posterior. Thus the anterior segment may be in the third stage and the posterior segment in the second. It is certain that the infiltration starts first in the exciting eye and that in a very short time, shorter than the clinical history leads one to believe, it begins in the fellow eye. As a proof of this brief interval, many eyes that have excited the disease reveal the specific infiltration in the choroid no further advanced than the first stage, when there is only a scattering of lymphocytes in and about large veins. If the interval were long, one would conclude that the removal of the injured eye at an early stage in the development of the infiltration would prevent the incidence of the disease in the other eye. Very exceptionally the sound eye becomes inflamed several days after the removal of its fellow. According to pathologic experience, now and then an eye shows the characteristic signs in the choroid in the earliest stage and yet the other eye never becomes inflamed. Such a condition is termed "pathologic sympathetic ophthalmia"—it being supposed that by chance the eye was removed before there was time for the disease to spread. As a still rarer occurrence no signs of sympathetic ophthalmia may be found under the microscope in the injured eye, and yet the clinical history states that the fellow eye was inflamed. This is called "clinical sympathetic ophthalmia."

DIFFERENTIATION FROM SEPTIC ENDOPHTHALMITIS

Sympathetic ophthalmia is a pathologic process entirely different both clinically and anatomically from septic endophthalmitis. Septic endophthalmitis remains localized in the injured eye, the vision of which

it destroys, but it produces no complications in the fellow eye. Anatomically the distinction lies in the character of the inflammation. The reaction of the tissues in septic endophthalmitis is an exudative one. The cells migrate from the blood vessels and have a high degree of mobility. They move quickly and get into the cavities of the eye, where they form pus. The granulation tissue which forms in the organization of the exudate is situated on the internal surface of the uvea and not in its stroma. On the other hand, the cells of sympathetic inflammation show no disposition to leave the stroma. In septic endophthalmitis the ciliary body and iris are inflamed, but not the choroid. In sympathetic ophthalmia, in addition to inflammation in the ciliary body and iris, without an apparent reason one finds the choroid infiltrated.

DIFFERENTIATION FROM GRANULATION TUMOR, ESPECIALLY TUBERCULOSIS

Many of the anatomic characteristics of sympathetic ophthalmia are closely related to those of the group of inflammations called granulation tumors. A granulation tumor is a new growth that has an aggressive power. It has no tendency to transform itself into cicatricial tissue but rather a pronounced tendency to degenerate. There are principally three diseases that belong to the group of granulation tumors—tuberculosis, syphilis and leprosy.

From a purely histologic standpoint the similarity between tuberculosis and sympathetic ophthalmia is strong. The same types of cells compose the infiltration in each disease, although there is a difference in the manner of their arrangement and distribution. In sympathetic ophthalmia the infiltration is more uniform than in tuberculosis, in which it tends to be more nodular. In sympathetic ophthalmia the emissaria almost invariably, even in the earliest and mildest cases, show an infiltration, but in tuberculosis this is seen only in a far advanced state. The distinguishing feature in the iris is the preference of tuberculous nodules for the anterior layers, leaving the posterior surface free, so that the movements of the iris are but little interfered with. Early and complete posterior synechiae characterize sympathetic inflammation. Neither in tuberculosis nor in sympathetic ophthalmia is the infiltration in the choroid ever as heavy at the equator as it is in the posterior half of this layer or in the ciliary body and iris. Presumably the reason lies in the fact that the original uveal tissue is thinner in the equatorial region than elsewhere, where it is more bountifully supplied with blood vessels. It is thought that the infiltration in the posterior part of the choroid in certain cases may be independent of that in the ciliary body and iris. Serial sections will show that there are islands of infiltration that form stepping stones between the two major zones of infiltration. The outstanding difference between the two diseases is the manner in which

the infiltration in each behaves toward the other tissues of the eyeball. Tuberculous infiltration possesses a histolytic action by which it destroys the densest structures. If it starts in the iris it will gradually fill the anterior chamber and on coming in contact with the cornea and sclera will melt them, so to speak, producing an excavation in them of the same size and shape as the tumor itself. This destructive malignancy is not noticed in sympathetic infiltration, which causes no atrophy in the fibrous tissue. Caseation typifies all tuberculous infiltrations, and while it is not often seen in sympathetic infiltration, it is well to remember that it occurs. There is no doubt that the infiltration in tuberculosis is an expression of reaction on the part of the uvea to acid-fast bacilli, but no micro-organisms are demonstrable in sympathetic infiltration. Meller and his school in Vienna believe that the disease is caused by the tubercle bacillus. They report success in isolating the tubercle bacillus from the exciting eye and from the blood of patients afflicted with sympathetic ophthalmia. The question is open to controversy.

THERAPEUTIC AND SURGICAL NOTES

The pathologic anatomy explains the intractability of sympathetic ophthalmia and its utter hopelessness when the infiltration is fully developed. As a rule it is useless to attempt local treatment of the exciting eye, because of its soft and atrophic condition. The infiltration may cause an increase in tension, especially in the sympathizing eye, because of the enormously thickened root of the iris and complete posterior synechia. Great difficulties arise in any endeavor to reduce the tension. Atropine, if it could act in the presence of massive infiltration, would increase the tension by bringing more tissues into the angle. Pilocarpine would make the synechia more complete at the pupil. Surgically an iridectomy is out of the question because of the transformation of the iris into granulation tissue. Neither may a cyclodialysis be made, because the ciliary body is often highly infiltrated and hemorrhages would take place from the rupture of engorged vessels, complicating the picture. No form of sclerotomy is permissible since scleritis is a common complication of sympathetic ophthalmia. From the surgical standpoint the cornea is the only field that is available for operation, on account of its freedom from inflammation. Repeated paracenteses are of great value in the relief of the secondary glaucoma in the sympathizing eye. They should be made well away from the inflamed and dehiscent zone at the limbus. The glaucoma of sympathetic ophthalmia is not likely to be of long duration, as the condition of the eye ends in hypotony. Secondary glaucoma is not so dangerous as primary glaucoma.

Above all else, sympathetic inflammation is remarkable for its chronicity. It is subject to periods of remission and exacerbation. It

is only after years that the infiltrated areas in the uvea may be converted into membranes. No attempt should ever be made at extraction of a cataract or at making openings in the iris unless there is a definite reason, and only then provided that the eye has been quiescent for a very long time. The reaction after an operation does not set in at once, but gradually a plastic exudate is poured out that bridges over any artificial opening that has been made for optical purposes.

Finally, in the matter of preventive measures, an evisceration may be dangerous because it is not possible to remove the uveal extensions in the emissaria. It is good practice to excise phthisical eyeballs after panophthalmitis, because laboratory experience teaches that even in these some uveal tissue escapes destruction. In enucleating, care should be taken to excise a long strip of the optic nerve and with it the tissues adjoining the posterior segment of the eyeball, since no one can tell how far from the sclera the specific infiltration may be. According to clinical experience, the earlier the enucleation of the injured eye is made, once sympathetic ophthalmia has developed, the more favorable will be the prognosis. This corresponds to the anatomic observations. Thus when the infiltration is seen under the microscope to be in the first stage, the fellow eye usually retains serviceable vision and may even recover completely. Unfortunately this rule has exceptions: A child, three months after an injury, began to have precipitates on the cornea of the fellow eye. An enucleation of the exciting eye was immediately performed. The microscopic examination of the exciting eye revealed a lymphocytic infiltration in the iris at the wound. In the choroid there were only a few early foci of lymphocytes about the veins, and the emissaria were free. However, the fellow eye became violently inflamed and was soon totally blind. Each case of sympathetic ophthalmia has the possibility of being a law unto itself.

TREATMENT OF IRIS BOMBÉ BY IRIDECTOMIA AB EXTERNO

REPORT OF CASES

WARREN D. HORNER, M.D.
SAN FRANCISCO

It occasionally happens in an attack or attacks of iritis that the whole pupillary margin of the iris becomes bound down to the lens in the form of a ring or annular synechia. This interrupts the passage of aqueous from the posterior to the anterior chamber. Accumulated hydrostatic pressure behind the iris causes it to bulge forward in the shape of a doughnut or umbrella, a condition designated in ophthalmic parlance as iris bombé or ballooning of the iris. The protrusion is not usually equal all around but is furrowed by depressions where the iris is bound down by adhesions.

The pupil appears as a crater and seems farther depressed because of the bulging of the surrounding iris. The latter may almost fill the anterior chamber, while the forward displacement at the periphery is liable to bring the iris in contact with the cornea, closing the angle of the anterior chamber. This and the seclusion of the pupil cause secondary hypertension. Such eyes usually show ciliary injection and are often painful. The pressure and stretching to which the iris is subjected and the absence of normal movement generally result in atrophy.

Treatment of such an eye is imperative since without attention it is almost certain to undergo degenerative changes that will render it hopelessly blind.

Iridectomy, when possible, relieves the situation since it not only reestablishes the communication between the posterior and anterior chambers but frees the angle.

Vision may also be improved in certain cases in which the pupil has been closed over with exudate (occlusio pupillae) as well as bound down (seclusio pupillae).

When the anterior chamber is too shallow to admit entrance by the keratome the classic operation is transfixion of the iris as devised by Fuchs [1] in 1896.

From the Department of Ophthalmology, University of California Medical School.

Read at the meeting of the Pacific Coast Oto-Ophthalmological Society, Portland, Ore., May 23, 1935.

1. Fuchs, E.: Ber. ü. d. Versamml. d. deutsch. ophth. Gesellsch., 1896, p. 179.

A slender Graefe knife is thrust through the cornea near the temporal limbus; it traverses the anterior chamber horizontally, making four small punctures in the doughnut-shaped iris en route and finally a counterpuncture of the cornea opposite. The inequality of pressure is relieved, and the iris becomes flat once more. In a week or so, when the anterior chamber has regained its depth, an iridectomy is performed. Should peripheral adhesions between the iris and cornea persist in blocking off the filtering angle, an anterior sclerectomy or cyclodialysis may be necessary.

As a substitute for these procedures, iridectomia ab externo offers many advantages. It is the purpose of this paper to emphasize this operation, which is too little known and practiced.

The principle involved, namely, the cutting into the anterior chamber from without, is credited to Gayet [2] and Dianoux.[3] Dehenne,[4] whose method was warmly advocated by Czermak, Streatfeild [5] and Deschamps,[6] also perforated the anterior chamber through scleral incisions from the outside. In addition to these must be mentioned Burchart (1892), Dufour,[7] Fleischer,[8] von Mende,[9] Wiegmann,[10] Groes,[11] Elschnig [12] and Lundgaard.[13]

These operators varied widely in their procedures both as regards the instruments used and in theoretical considerations. The principle alone was similar. Many perforated the sclera in only a small section and enlarged the incision by scissors or a ball-tipped knife.

The idea of gradual perforation of the corneoscleral junction from without came later to be employed in fistula operations (Fleischer,[8] who mentions Priestly Smith and Adams). Here belongs also the method of Foroni,[14] which was warmly advocated by Saggini.[15]

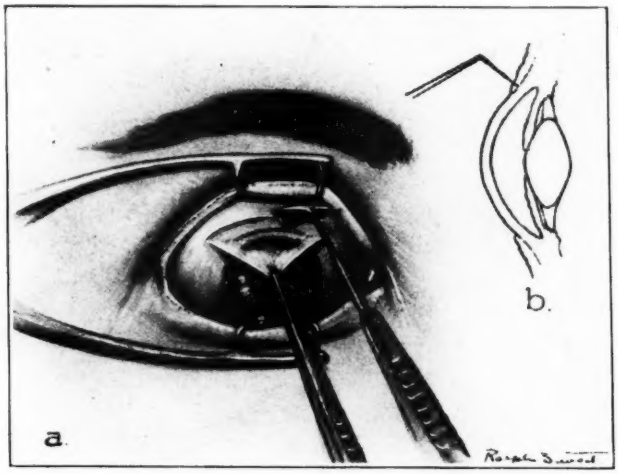
While originally intended for those cases in which a shallow anterior chamber or absence of one made the classic section impossible, Zirm [16]

2. Gayet: D'un procédé réglé d'ouverture de la chambre antérieure, Bull. et mém. Soc. franç. d'opht. **2**:41, 1884.
3. Dianoux: Bull. et mém. Soc. franç. d'opht. **2**:44, 1884.
4. Dehenne, A.: Ann. d'ocul. **100**:120, 1888.
5. Streatfeild: Compt. rend. Cong. period. internat. d'ophth. de Leondres, 1873, p. 154.
6. Deschamps: Ann. d'ocul. **127**:101, 1902.
7. Dufour, M., quoted by Ladame-Ievleff, E.: Ann. d'ocul. **125**:31 (Jan.) 1901; Ophthalmoscope **7**:530 (Aug.) 1909.
8. Fleischer: Klin. Monatsbl. f. Augenh. **74**:169, 1925.
9. von Mende, R.: Klin. Monatsbl. f. Augenh. **50**:540, 1912.
10. Wiegmann, E.: Klin. Monatsbl. f. Augenh. **64**:117, 1920.
11. Groes: Acta ophth. **3**:69, 1926.
12. Elschnig: Klin. Monatsbl. f. Augenh. **80**:382, 1928.
13. Lundgaard: Acta ophth. **6**:311, 1928.
14. Foroni, C.: Soc. ital. di oftal., Roma **55**:1004, 1927; **56**:82, 1928.
15. Saggini: Boll. d'ocul. **4**:164, 1925.
16. Zirm, E.: Klin. Monatsbl. f. Augenh. **82**:93, 1929.

widened the scope of the operation to include all glaucomas, regardless of the depth of the chamber.

Carreras [17] claimed to have used this technic since 1927, but as he regarded it as a modification of the Foroni operation he did not publish a report of his cases until after Elschnig's and Salzmann's articles appeared. According to Elschnig, the technic and procedure must be designated as the method of Gayet.

The name "iridectomia ab externo" is derived from the "sclerectomia ab esterno" of Foroni and was suggested by Salzmann.[18] Since March 1929, Salzmann has performed the operation in a large series of cases which included not only all types of glaucoma but several tumors of the iris as well. He used the method of Elschnig which is as follows:



Drawing to show operative procedure in iridectomia ab externo.

After local instillation of cocaine and epinephrine hydrochloride, and akinesis, the operation starts with a subconjunctival injection of procaine hydrochloride near the insertion of the superior rectus muscle.

A horizontal incision is made by scissors 6 to 8 mm. from the upper limbus to form a broad conjunctival flap, which is dissected down to the limbus as in the trephine operation. The flap is then turned down over the cornea and is grasped with smooth thumb forceps for fixation. The sclera is then scratched 1 mm. behind the limbus and parallel to it, for about 7 mm., using the tip of a keratome. For excision of tumors or cysts of the iris a longer incision is required.

The incision is deepened layer by layer by scratching back and forth in the premarked groove. Slight traction on the conjunctival flap below causes the wound to gape and allows one to estimate the depth of the incision. The assistant sponges lightly after each stroke. When a perforation is made at one spot, a small prolapse of iris occurs near its root. This usually prevents outflow of

17. Carreras: Arch. de oftal. hispano-am. **31**:369 (Sept.) 1931.
18. Salzmann: Ztschr. f. Augenh. **72**:127, 1930.

aqueous. Cuts are continued to each side of the prolapse until the wound is widened to about 5 or 6 mm. The incision is enlarged with the tip of the keratome but not with scissors. Insertion of instruments into the anterior chamber is to be avoided. While aqueous may flow out during the widening of the incision, the anterior chamber does not completely empty. Fuchs [19] applies a few drops of cocaine directly to the prolapsed iris before proceeding with the next step, the iridectomy.

If after completion of the incision no prolapse occurs, it usually signifies the presence of peripheral synechiae. In such cases the iris must be separated from the lips of the wound by a spatula. Adhesions at the pupillary edge of the iris also may prevent prolapse. In both instances, traction on the conjunctival flap lifts the edge of the wound and allows easy insertion of iris forceps with which to grasp and pull out a suitable piece of iris.

In the ordinary case, however, it is not necessary to insert any instrument into the chamber. The prolapsed iris is simply grasped with forceps, pulled forward and to the side with some force and abscised by several snips of de Wecker's scissors pressed against the sclera. At this point, the remaining aqueous flows out. Reposition of the iris is accomplished by massaging the edges of the wound with a spatula from the outside. Only twice in forty cases was Salzmann forced to introduce a spatula into the wound to replace a pillar. The conjunctival flap is now stroked into place and need not be sutured. The administration of atropine is advised.

Bleeding into the anterior chamber almost never occurs during the operation, although it may appear later in the day, particularly if the iris is hyperemic or inflamed. The blood absorbs spontaneously.

The chamber is usually abolished for several days and reestablishes itself as a rule more slowly than following the classic keratome section. Salzmann has never encountered a true separation of the wound, so the postoperative care need not be especially strict.

The advantages of iridectomia ab externo as given by Salzmann, Fuchs [19] and Carreras [17] are as follows:

1. It is applicable to any case in which a simple iridectomy should be done.

2. It is of particular service in cases in which, because of a shallow chamber, the classic operation would be difficult or impossible.

3. It is far more simple to perform than the ordinary scleral section.

4. Better local anesthesia is possible. Subconjunctival injection makes the incision painless. The grasping and drawing forth of the iris causes surprisingly little pain even in injected eyes.

5. There is practically no hemorrhage during the operation once the superficial bleeding has been stopped. No blood enters the anterior chamber until after the iridectomy has been done, and then is rarely enough to cause trouble in replacing the pillars.

6. The eyeball is easily fixed by drawing down on the flap. The cutting strokes are light, so there is no danger of wounding the lens by

19. Fuchs, A.: Surgical Treatment for Iridocyclitis, Arch. Ophth. **11**:591 (April) 1934.

a failure of fixation or by a sudden perforation with the lancet or Graefe knife which, in the classic section, must be applied to the sclera with some force.

7. The perpendicular section is linear and regular and offers a peculiarly small tendency to open. It is also protected by a conjunctival flap.

8. It is unnecessary in most cases to insert an instrument into the anterior chamber. This reduces injuries to the lens both by surgeon and unruly patient.

9. The tension in a hard eye is reduced more gradually. This further reduces injuries to the lens by minimizing the chance of a spontaneous rupture of the anterior capsule. The lens has time to move forward and to accommodate itself gradually to its new position. Since the radius of curvature of the posterior surface of the cornea is 7 mm. and that of the anterior surface of the lens 11 mm., when the lens is forced against the cornea by strong pressure from behind, the anterior surface of the lens must mold itself and assume a greater curvature. This puts increased tension on the anterior capsule and may result in a spontaneous rupture, as has been pointed out by Salzmann.[18]

10. The operative shock to the eye seems to be less and recovery more rapid.

I wish to emphasize one more advantage. The incision is made in a leisurely manner, scratch by scratch, and one has the opportunity to see that it is going properly and that it will be of sufficient length. The classic section by keratome or Graefe knife must be made in a few seconds and with almost a single stroke that carries with it full responsibility as to its technical excellence, the safety of the lens and even the behavior of the patient.

My personal experience with iridectomia ab externo is not large, being limited to seven cases to date. However, the ease with which it is done and its obvious advantages have made me enthusiastic about it.

I wish to report results in 5 cases of iris bombé in which this technic was used with satisfaction.

REPORT OF CASES

CASE 1.—F. R., a man aged 49, a stevedore, reported July 8, 1932, complaining of difficulty with fine print. He had had several attacks of iritis in both eyes, more severe in the right. The last attack had occurred in the right eye a year previous to examination.

Examination showed vision in the right eye to be that of light of chart only, and vision in the left eye, 1.

The right eye showed slight ciliary injection, a very shallow anterior chamber, an iris bombé and a contracted pupil occluded by organized exudate. The tension

was 45 (Schiötz). The left eye showed some old posterior synechiae but was otherwise normal.

Four days later, iridectomia ab externo was performed on the right eye, according to the usual technic and with the use of local anesthesia. A conjunctival flap was prepared and the incision was made, stroke by stroke, 1 mm. behind the upper limbus and about 5 mm. long. Perforation into the anterior chamber did not result in prolapse of the iris since the latter was adherent at the pupillary margin. An iris forceps was introduced, the iris seized near the pupil and a piece torn away and abscised. The resulting coloboma was small and regular. The new pupil was partially occluded inferiorly by iris pigment which remained attached to the lens, but was clear in its upper two thirds. The intra-ocular tension fell, the iris became flat, and the eye healed without incident. Vision was increased by the iridectomy from perception of light of chart to 0.1 plus. Examination six months later showed normal tension, and the coloboma was still open. The lens showed beginning complicated cataract. Extraction was advised, but the patient has not returned.

CASE 2.—Mrs. F. L., aged 39, was seen on March 8, 1933. She complained of a reddened left eye and poor vision in both eyes.

Vision in the right eye was that of fingers at 1 foot (30.4 cm.); with myopic correction, 10/200. Vision in the left eye was that of fingers at 1 foot; with correction, 4/200.

The right eye showed myopic fundus changes. The left eye presented mild subacute iritis. The iris was muddy, and there were bits of exudate and pigment deposits on the lens. The anterior chamber contained many cells. The pupil could not be fully dilated. Tension was at the upper limits of normal, gradually increasing to 50 (McLean) in the next four weeks in spite of therapy. The pupil became firmly bound down, and the iris showed a beginning balloon-like swelling.

On April 10, iridectomy from the outside was performed. No prolapse of the iris occurred during the incision. It was necessary to separate peripheral synechiae with a spatula before the anterior chamber could be entered. The iris was seized with the forceps and with a side to side maneuver was pulled loose from its adhesions and a piece abscised. The coloboma was regular and of satisfactory size. Postoperative treatment consisted of the administration of atropine and application of hot compresses. On the fourth day a spontaneous hemorrhage occurred which filled the anterior chamber. Tension rose to 2 plus. Blood from this hemorrhage was still present one month later. The eye was hard but not painful.

Four months after the iridectomy, a cyclodialysis was performed with small hope of success. Considerable bleeding into the anterior chamber occurred during the operation, and the following day the red reflex was absent owing to a posterior hemorrhage. Tension dropped on the third day but rose later to 2 plus. Three months later the chamber was found filled with yellowish hemorrhagic remains, with some fresh blood inferiorly. The cornea showed blood staining in its middle and deep layers. The site of the coloboma was covered by exudate. The tension gradually fell, perception and projection of light became faulty, and the eye was finally enucleated.

CASE 3.—Mrs. M. H., aged 51, was seen on Nov. 21, 1933 in an emergency house call on account of a reddened painful right eye. There was a history of previous iritis.

The right eye presented acute hypertension, iris bombé, seclusio pupillae and cataract. Vision was reduced to perception and projection of light. The anterior chamber was obliterated. An iridectomy from without was performed under gen-

eral anesthesia. The iris failed to prolapse when the incision was complete since the iris was bound down both at the pupil and at the periphery. The peripheral synechiae were separated by a spatula. An iridectomy was performed without difficulty, the iris pulling loose from the lens nicely. The coloboma was regular and of satisfactory size. Convalescence was uneventful. Six days later, the eye was soft, comfortable and only slightly injected. This patient was advised to return for a cataract extraction but has not done so.

CASE 4.—B. H., aged 68, presented herself because of a painful blind left eye. There had been no vision for the past three years. Examination showed the right eye to be normal with the exception of some old iritic deposits of pigment on the anterior surface of the lens. The left eye was divergent and somewhat injected. The lens was partially cataractous, hiding a view of the fundus. The pupil was small and bound down by ring synechiae. There was a beginning iris bombé, but the anterior chamber still retained a fair depth. Tension was high, up to 90 (McLean). Iridectomia ab externo was performed with the idea of restoring normal tension and relieving pain. The technic proceeded smoothly under local anesthesia. No prolapse of the iris occurred during the incision. A satisfactory iridectomy was performed by introducing the forceps within the anterior chamber and withdrawing a suitable piece for abscission.

A moderate hemorrhage into the anterior chamber occurred on the third postoperative day, explained probably by the patient's statement of "rolling over" on the eye at night. The blood absorbed without incident. The tension has remained down, and the eye is painless.

CASE 5.—B. E., aged 61, was first seen on April 11, 1935, complaining of recurring iritis, bilateral. Vision in the right eye was reduced to perception of light. The pupil was bound down to the lens by ring synechiae. There was a beginning iris bombé, but the chamber still maintained reasonable depth. A partial secondary cataract prevented a view of the fundus. The tension was 1 plus.

Vision in the left eye was normal. There were a few old synechiae, but the eye was otherwise in good order.

On May 2, iridectomia ab externo was performed on the right eye, by election, since the chamber was of sufficient depth to allow the usual keratome incision.

Local anesthesia was used. No prolapse of the iris occurred after the incision because of dense peripheral synechiae in addition to the pupillary adhesions. Iris forceps were introduced and a satisfactory iridectomy accomplished. A small amount of blood remained in the anterior chamber, but this disappeared in the following two days. Tension has remained down, and the eye is comfortable.

COMMENT

One does not need to draw conclusions from such a small series of cases. The value of the operation has already been established by Elschnig, Salzmann, Carreras and others. However, the series does serve to emphasize the worth of iridectomia ab externo in iris bombé when the anterior chamber is too shallow to permit of anything but a transfixion as in cases 1 and 3. In all five cases, a satisfactory coloboma was obtained in spite of complete annular synechiae. In all five cases it was necessary to insert iris forceps into the anterior chamber.

Case 2 illustrates the type in which the eye should be operated on only as a last resort and as an "unpleasant duty." As Fuchs has aptly

stated, "a diseased eye sometimes will not tolerate even a very slight operation, which may lead either to an exacerbation of the uveitis already present or to a fresh attack." The complications and loss of the eye in case 2 must be attributed to this factor and not to the type of operation performed.

Cases 4 and 5 were elective, there being sufficient depth to the chamber to allow the classic keratome incision to be made if desired.

In closing, I should further emphasize the simplicity of the technic in this type of iridectomy, its wide application and the markedly lessened hazards of injury to the lens which it entails.

BIOCHEMISTRY OF THE LENS

V. CEVITAMIC ACID CONTENT OF THE BLOOD AND URINE OF SUBJECTS WITH SENILE CATARACT

JOHN BELLOWS, M.D.*

CHICAGO

Much interest has been aroused by the finding of vitamin C, or cevitamic acid, in the lens and aqueous by Harris,[1] and by Birch and Dann.[2] Its presence was confirmed by Müller and Buschke,[3] Euler and Martius,[4] Fischer,[5] Monjukowa and Fradkin [6] and Bietti.[7] In addition, they found that cevitamic acid was absent or diminished in quantity in the aqueous of cataractous and aphakic eyes. According to these authors, the quantities of cevitamic acid are surprisingly large when compared with the amounts in other body tissues and fluids. The values given by Müller and Buschke for the vitamin C content of the human lens and aqueous are 30 and 12 mg. per hundred cubic centimeters, respectively. Farmer [8] determined the cevitamic acid content of the normal human blood plasma to be between 1 and 2 mg. He found that the amount of reduced cevitamic acid in the blood follows closely the intake of vitamin C. The cevitamic acid concentration in the lens and in the aqueous varies with the species of animal, and there are marked differences between the concentration in old and that in young animals of like kind. A young animal has a higher concentration of cevitamic acid in the lens and a lower concentration in the aqueous than an older animal. Monjukowa and Fradkin observed that opacity of the lens developed in a small percentage of guinea-pigs fed a scorbutic diet.

The origin of cevitamic acid in the lens and aqueous is yet to be determined. The fact that the concentration in the aqueous is about

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* Ward Fellow in Ophthalmology.

From the Department of Ophthalmology, Northwestern University Medical School.

1. Harris, L. J.: Nature, London **132**:27, 1933
2. Birch, T. W., and Dann, W. J.: Nature, London **131**:469, 1933; Biochem. J. **28**:638, 1934.
3. Müller, H. K., and Buschke, W.: Arch. f. Augenh. **108**:368 and 592, 1934.
4. von Euler, Hans, and Martius, Carl: Ztschr. f. physiol. Chem. **222**:65, 1933.
5. Fischer, F. P.: Klin. Wchnschr. **13**:596, 1934.
6. Monjukowa, N. K., and Fradkin, M. J.: Arch. f. Ophth. **133**:328, 1935.
7. Bietti, G.: Boll. d'ocul. **14**:3, 1935.
8. Farmer, C. J., and Abt, A. F.: Proc. Soc. Exper. Biol. & Med. **32**:1625, 1935; personal communication to the authors.

twelve times higher than that in the blood plasma apparently rules out a simple filtration process. The following explanations have been offered: Van Eekelen, Emmerie, Josephy and Wolff [9] have shown that after the ingestion of large quantities of orange juice a greater increase in the concentration of cevitamic acid appears in the urine than in the blood. Bietti has shown that there is a marked rise in the amount of this substance in the aqueous of rabbits fed orange juice. These authors have expressed the conclusion that a selective filtration of vitamin C occurs in various parts of the body.

A second explanation has been given by F. P. Fischer, who stated that dextrose reacts with cystine in the lens to form cevitamic acid and cysteine. Because of the permeability of the lens capsule, the cevitamic acid escapes from the lens into the aqueous.

A third explanation has been given by Müller and Buschke, who stated that cevitamic acid occurs in three forms, namely, a reduced form; a reversibly oxidized form, which can be reduced by hydrogen sulphide, and an irreversibly oxidized form which, as the name implies, cannot be reduced. These authors have shown that in vitro a lens in aqueous exerts a preserving action on the vitamin C content of the aqueous. A corresponding amount of aqueous without a lens shows a marked loss in its cevitamic acid content at the end of five hours. Furthermore, Goldmann and Buschke [10] have demonstrated that the vitamin C in the normal aqueous is wholly in the reduced form, while in an aphakic eye the reduced form tends to disappear and the reversibly oxidized form appears. From these observations one may theorize as follows: The cevitamic acid reaches the aqueous from the blood stream. There the reversibly oxidized form by means of dehydrogenation becomes reduced and thus plays a part in the normal oxidation-reduction processes of the lens. In this way the reversibly oxidized form is continually being changed into the reduced form, and a piling up of this substance occurs in the aqueous.

The absence or diminution of cevitamic acid in the aqueous and in the lens of cataractous eyes and in the aqueous of aphakic eyes brings forth the question of the relationship of vitamin C and cataract. Is the loss of vitamin C secondary to the changes in the lens, as Bietti has suggested, or does its diminution or deficiency precede the development of opacities in the lens?

Senile cataract develops gradually and can very likely depend on a change or a deficiency in the normal constituents of the blood. While frank cases of scurvy are relatively rare in adults, cases of vitamin C

9. van Eekelen, M.; Emmerie, A.; Josephy, B., and Wolff, L. K.: Klin. Wchnschr. **13**:564, 1934.

10. Goldmann, H., and Buschke, W.: Klin. Wchnschr. **14**:239, 1935.

subnutrition are very common. Harris and Ray,[11] from a study of the urinary output of cevitamic acid in adults, concluded that a subclinical form of scurvy is not uncommon. This condition is especially frequent in the late spring months, when the body stores are depleted after a long winter on a diet with a limited amount of fresh fruit and vegetables. The frequency of cataract in India, where the main article of diet is formed by cereals, is well known. In this regard may be cited the recent report of H. T. Pi[12] that senile cataract, although uncommon in China because of the short average span of life, occurs at an age from five to ten years earlier than in Germany or Japan.

EXPERIMENTAL STUDY

With the question of the relationship of vitamin C and cataract in mind and at Dr. Gifford's suggestion that a study of the cevitamic acid content of the blood and of the urine of cataractous and noncataractous persons may throw some light on this subject, the following investigation was undertaken.

The subjects chosen for examination were in approximately the same economic and age groups. The morning specimen of urine was taken as being the most representative. Blood was obtained from a vein during the hours between 9 a. m. and 1 p. m.

The determination of the cevitamic acid content of the urine was performed by the method of Harris and Ray, with the slight modification of delivering the dye from a microburet into a sample of urine rather than by the reverse process. The indicator used was sodium 2:6 di-chlorobenzenone-indophenol, which was standardized against cevitamic acid, which in turn was standardized against a solution of iodine.

For the determination of the cevitamic acid content of the plasma the method followed was that of Farmer. That procedure gives the amount of reduced cevitamic acid present and is, according to Farmer, an accurate indicator as to the relative state of vitamin C nutrition. The method consists in drawing 10 cc. of blood and oxalating it with 20 mg. of lithium oxalate. Then the blood is centrifugated. Two cubic centimeters of plasma is drawn into a tube, and to it are added in the following succession: 4 cc. of distilled water, 2 cc. of 5 per cent sodium tungstate and 2 cc. of third-normal sulphuric acid. The contents are mixed by shaking and then centrifugated. The clear filtrate is titrated against the standardized dyestuff.

Table 1 shows the cevitamic acid content of the morning specimen of urine of six cataractous and six normal subjects. Conclusions cannot be drawn from the results obtained, because great variations were present. They arose because of the varying amounts of urine voided and the varying intervals between the voiding of the urine and its examination, which caused changes in the cevitamic acid concentration.

Table 2 shows the results of the determination of the cevitamic acid content of the blood plasma of twenty normal and twenty cataractous subjects. As can

11. Harris, L. J., and Ray, S. N.: Lancet **1**:71, 1935.
12. Pi, H. T.: Chinese M. J. **48**:928, 1934.

be seen, the cevitamic acid content in the subjects in the first group was distinctly greater than that in the subjects in the second group. Although in the second group there were subjects with a cevitamic acid content as high as or even higher than that of some in the group of normal subjects, the average (0.605 mg. per hundred cubic centimeters) was definitely below that in the second group (1.02 mg.). The lowest and the highest value in the group of cataractous subjects

TABLE 1.—*Cevitamic Acid Content of Urine of Cataractous and Normal Subjects*

Cataractous				Normal		
Patient	Age, Years	Type of Cataract	Cevitamic Acid in Urine, Mg. per Cc.	Subject	Age, Years	Cevitamic Acid in Urine, Mg. per Cc.
M. B.	62	Cortical and nuclear	0.0039	Rose F.	64	0.0142
A. F.	70	Cortical and nuclear	0.0053	Mary K.	60	0.0026
M. K.	61	Cortical	0.0162	Miss Q.	55	0.0065
R. F.	74	Cortical	0.0162	Mrs. A.	55	0.0020
E. F.	50	Cortical	0.0117	Anton S.	52	0.0100
Laura F.	63	Cortical	0.0029	John B.	63	0.0213

TABLE 2.—*Cevitamic Acid Content of Blood Plasma of Cataractous and Normal Subjects*

Cataractous				Normal		
Patient	Age, Years	Type of Cataract	Cevitamic Acid in Blood Plasma, Mg. per 100 Cc.	Subject	Age, Years	Cevitamic Acid in Blood Plasma, Mg. per 100 Cc.
M. K.	61	Cortical	0.765	K. M.	60	0.796
M. S.	73	Nuclear and cortical	0.610	M. Q.	55	1.034
M. C.	55	Cortical	0.466	I. S.	52	0.956
M. V.	75	Cortical	0.992	J. C.	57	1.259
E. S.	63	Cortical	0.872	J. R.	?	0.956
F. C.	84	Cortical and nuclear	0.439	V. R.	52	1.213
T. F.	63	Cortical	0.894	N. M.	39	0.982
C. W.	55	Cortical and nuclear	0.439	M. W.	51	0.724
L. M.	63	Cortical	0.439	E. W.	46	0.647
E. F.	50	Cortical	0.488	W. C.	45	2.017
G. B.	81	Cortical	0.523	E. D.	58	1.174
J. M.	60	Cortical	1.070	O. H.	64	0.971
M. O'G.	70	Nuclear	0.587	J. A.	58	0.523
M. M.	63	Cortical	0.872	A. K.	45	1.733
I. W.	60	Nuclear	0.400	L. M.	45	0.512
J. D.	55	Nuclear	0.512	J. F.	54	0.523
H. S.	65	Cortical	0.445	O. S.	43	0.623
J. T.	81	Cortical	0.434	P. T.	50	1.050
C. B.	70	Cortical	0.540	O. T.	50	1.440
T. A.	73	Cortical	0.411	J. R.	59	1.175
Average			0.605	Average		1.020

were 0.4 and 1.07 mg., respectively; and those in the group of normal subjects were 0.512 and 2.017 mg., respectively. There was only one subject in the first group for whom the value was over 1 mg., or the lowest normal limit, while in the group of normal subjects there were ten with values of over 1 mg.

The next step in the investigation was to determine the response to a vitamin C intake in cataractous and in normal subjects.

After the cevitamic acid content of the blood plasma had been determined by the method previously outlined, 150 cc. of orange juice was given by mouth. After thirty minutes blood was again drawn, and its vitamin C content was determined.

Table 3 shows that the blood plasma of cataractous subjects had a low cevitamic content, which remained unchanged after the ingestion of orange juice. In fact, a slight decrease was observed in two cases. On the other hand, the normal subjects showed a distinct increase in the concentration of cevitamic acid in the blood plasma thirty minutes after the ingestion of orange juice.

One of the cataractous patients was given ½ pint (236 cc.) of orange juice daily for one week. At the end of that time the cevitamic acid content had increased from 0.54 and 0.492 mg. to 0.92 mg. per hundred cubic centimeters of blood plasma.

These results show that in a cataractous subject much larger quantities of vitamin C are required to raise the value in the blood plasma than in a normal person. The interesting observation was made by

TABLE 3.—*Cevitamic Acid Content of Blood Plasma Following Ingestion of Orange Juice*

Patient	Years	Diet	Cevitamic Acid in Blood Plasma, Mg. per 100 Cc.		
			First Determination	30 Min. After Ingestion of Orange Juice	Percentage of Increase
Cataractous					
C. B.	70	Seldom ate fruits or vegetables	0.540	0.492	0
				0.920*	70
J. M.	70	Did not like fruit; ate about 1 orange a week	0.492	0.380	0
T. A.	73	Seldom ate fresh fruit or vegetables	0.411	0.434	3
Normal					
P. T.	50	Occasionally ate an orange	1.050	1.310	25
O. T.	50	Drank orange juice every day	1.440	1.720	20
J. R.	59	Rarely ate fruits or vegetables	1.175	1.292	10
M. V.	56	Seldom ate fruits or vegetables	0.764	1.034	36

* After the patient had been drinking orange juice for one week.

Bietti that in dogs after the ingestion of orange juice a slight and only transient increase of the vitamin C content in the aqueous humor occurs, while in rabbits under similar conditions there is a marked increase, which is persistent. This difference in the responses of the two species of animals to orange juice may be of the same nature as that in the two groups of human beings. One is forced to conclude from these observations that of two groups of subjects, one with cataractous and the other with normal lenses, the former group have a low vitamin C content in the blood plasma, while the second group have a much higher concentration of this substance in the blood; and that in the first group a larger quantity of cevitamic acid is required before an increase is demonstrable in the blood. In other words, the behavior of vitamin C after ingestion is distinctly different in the two groups. This is in

accordance with the observation of Aschoff and Koch [13] from clinical and pathologic studies that individual requirements of vitamin C are variable.

The effect of a scorbutic diet on the lenses of guinea-pigs was studied. Twelve guinea-pigs were kept on a vitamin C-free diet. The longest time of survival was two months, but no changes in the lenses were noted with the ophthalmoscope and the slit lamp.

CONCLUSION

The cevitamic acid contents of the blood plasma of cataractous and normal subjects are compared. Cataractous subjects have a distinctly lower concentration of this substance than normal subjects. The average value for twenty cataractous patients was 0.605 mg., and that for normal subjects was 1.02 mg., per hundred cubic centimeters.

The response in the vitamin C content of the plasma to the ingestion of cevitamic acid differs in the two groups; i. e., in the cataractous subject a larger quantity of vitamin C is required to cause an increase in the content than in a normal subject.

The finding of a lower cevitamic acid content in the blood of cataractous subjects than in that of normal subjects leads to the conclusion that a diminution in the amount of this substance in the aqueous and in the lens of cataractous eyes precedes the development of opacities and is not secondary to it, as Bietti suggested.

On the basis of these results vitamin C is being given to subjects with incipient cataract in order to observe its influence, if any, on the progress of the disease; although it is recognized that the course in these cases is variable under ordinary circumstances.

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13. Aschoff, L., and Koch, W. K.: Skorbut: Eine pathologisch-anatomische Studie, Jena, Gustav Fischer, 1919.

REPLY TO CRITICISMS OF MY THEORY ON THE GENESIS OF MYOPIA

PROF. DR. G. LEVINSOHN
TEL-AVIV, PALESTINE

The proof of my theory on the causation of myopia is obvious. In addition to various clinical observations and theoretical considerations, I submit the following evidence:

1. It has been demonstrated by me, and later by others, that the eye drops when the body and head are bent forward.

2. I have observed that it is possible to make apes myopic in most instances if the animals are kept in a horizontal position. (This test was used by others and found to be correct.)

3. It has been observed that the characteristic signs of myopia often develop in artificially short-sighted animals. (This has been confirmed by others.)

4. The anatomic alterations of the officially short-sighted animals are very similar to those seen in the human myopic eye. This is confirmed by others.

5. Finally, a physical test was devised. I have demonstrated that a rubber ball attached to a string will alter its contour at that point where it is connected with the string if it is suspended and if the center of gravity is displaced. The new shape of the ball will be similar to the shape of a human myopic eye.

From the reports of several ophthalmologic societies and from various ommunications, I observe that in spite of the accuracy of my tests, hesitancy and doubt are still expressed as to the accuracy of my theory on the genesis of myopia. This is the reason that it is necessary to answer once more the continually repeated objections which long ago were proved wrong. The most important objections are:

1. How is it possible if the lengthening of the eye is produced by displacement of gravity that not all eyes become myopic?

2. How is it possible that often only one eye becomes myopic or shows a greater development of myopia than the other?

3. How is it possible that in so many professions in which work is performed with great bending of the body and head there are only a few cases of myopia?

The answer to these questions shall, I think, be given best together. I shall begin by asking a counter-question. How is it that in all general diseases occasionally only one eye is affected and not both? The same

poison runs equally in the veins of both eyes, and the same injury attacks both eyes at the same time; nevertheless, there is a different reaction. The answer to that question was never difficult. It is well known that both parts of the body are not at all equal; it is also known that the disposition of the two halves of the body is often very different. It is very evident that a locus minoris resistentiae in entirely similarly constructed organs can exist on one side and be absent from the other. Why should it be otherwise in the eyes? It is known that the refraction of each eye is not always the same after birth; sometimes even, although rarely, one eye is hypermetropic and the other myopic. It is natural that in the latter case, if a mechanical injury attacks the two eyes, the effect will be very different in the two. The disposition will in all cases have the greatest importance, and it is very clear that many an eye will not become myopic although it is permanently subjected to deteriorating treatment. Even the experiments on apes have proved that not all become myopic, although all of the animals were subjected to the same treatment.

Concerning the fact that in many a profession connected with a great bending of the body and the head the percentage of short-sighted persons is very small, it may be remembered that after full development of the body, i. e., about the eighteenth year, the eye has lost the quality of stretching. After this period the sclera has greater resistance, and the eye is not able to become myopic, but it is different in a distorted eye. In such a case the sclera will have lost its resistance, and myopia will increase if the defect is not corrected.

It is astonishing that in spite of the definitely established origin of myopia, experiments in this connection have not yet been made on human beings. It is even more striking because the control of myopia was until this time built up on hypotheses, fancies and theoretical calculations. It is time that the findings of my theory on the genesis of myopia should be taken into consideration. The combat against myopia must be conducted in three ways: (1) enlightenment of the population, especially of teachers and pupils; (2) strengthening the children during their growth by gymnastics in order to improve the resistance of the sclera, and (3) improving the general physique of children during their development.

There is no doubt that by observing the foregoing suggestions it will be possible to fight myopia effectively and thus greatly reduce the grave damages often caused.

BLOOD LIPIDS IN LIPAEMIA RETINALIS

ALEXANDER MARBLE, M.D.
AND
RACHEL M. SMITH, A.B.
BOSTON

Although in the literature there are reports of about forty cases of lipaemia retinalis,[1] detailed studies of the various blood lipids have been described in only a few instances. For this reason the results of the analyses made recently on two boys studied at the New England Deaconess Hospital seem worthy of record.

REPORT OF CASES

CASE 1.—Charles H. (case 8, table 3) was 16.7 years old when first seen on Jan. 15, 1934. The onset of diabetes was in December 1931, when he was 14.7 years old. Although since January 1932 he had been under dietary restrictions and had been treated with insulin, control of the diabetic condition had been poor since August 1933. Physical examination showed no noteworthy abnormalities except generalized xanthoma diabeticorum, slight thickening of the radial arteries and enlargement of the tonsils. Venous blood withdrawn on Jan. 15, 1934, was light pink. When the oxalated blood was allowed to stand the supernatant plasma appeared creamy. Examination of the optic fundi revealed the striking and characteristic appearance of lipaemia retinalis. Dr. H. F. Root noted at the time that the arteries and the veins looked alike, both appearing wide and flattened as well as milky. There was moderate acidosis; the urine gave a 4 plus reaction for aceto-acetic acid with ferric chloride and the carbon dioxide-combining power of the blood plasma was 22 volumes per cent. Although the urine contained 7.4 per cent sugar, there was only 0.25 Gm. of sugar per hundred cubic centimeters of blood, and the patient did not appear to be acutely ill. The acidosis quickly cleared up, and with regulation of the diet and adequate doses of insulin the patient did well. He was discharged from the hospital on January 23 on a diet of 151 Gm. of carbohydrate, 73 Gm. of protein and 92 Gm. of fat and was instructed to take 22 units of insulin before breakfast, 12 before lunch, 20 before supper and 4 at bedtime. He made office visits at frequent intervals until June 9, when the diabetes seemed under only fair control. He had become somewhat lax with regard to his regimen and on his own initiative had appreciably increased his diet. Despite that, on physical examination he seemed in good condition. The xanthoma diabeticorum had disappeared gradually and had not been present at an examination on May 3.

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Read in part at a meeting of the New England Ophthalmological Society in Boston, Jan. 15, 1935.

From the George F. Baker Clinic, Elliott P. Joslin, M.D., medical director, at the New England Deaconess Hospital.

1. Jaffe, M., and Schonfeld, W. A.: Lipemia Retinalis Due to Diabetes Mellitus, with Report of a Case, Arch. Ophth. **9**:531 (April) 1933.

In table 1 are shown the results of eight analyses of the lipids of blood secured at intervals starting with the first visit and continuing until essentially normal values were found. The initial level of total blood fat was very high, being over 14 per cent, or roughly twenty times normal. By far the greatest increase took place in the fatty acids. Next in order of increase were the cholesterol esters, then the free cholesterol and lastly the phospholipins. If the values recorded on January 16 are compared with those on March 15, it is noted that whereas the first values for total lipid were about seventeen times the second values, the first values for total cholesterol were nine times, those for cholesterol esters about eleven times and those for phospholipin phosphorus three and one-half times the values obtained on March 15. The ratio of ester cholesterol to total cholesterol fell from 80 per cent on January 16 to 66 per cent on March 15.

CASE 2.—John B. (case 9, table 3), aged 12.7 years, was admitted to the New England Deaconess Hospital on Jan. 17, 1934. Sugar was found in the urine first in September 1929, but it seemed likely that the onset of diabetes was in January

TABLE 1.—*Summary of the Blood Fat Values in Case 8*

Date	Total Lipid, Mg. per 100 Cc.	Fatty Acids, Mg. per 100 Cc.	Total Cholesterol, Mg. per 100 Cc.	Cholesterol Esters, Mg. per 100 Cc.	Cholesterol Ester-Total Cholesterol Ratio, per Cent	Phospholipin Phosphorus, Mg. per 100 Cc.	Iodine Number*
Jan. 16.....	14,103	12,430	1,596	1,275	80	46	77
Jan. 18.....	9,028	7,852	1,436	1,080	75	34	..
Jan. 19.....	7,442	5,876	1,394	1,070	77	31	..
Jan. 20.....	6,720	5,216	1,387	1,060	76	30	..
Jan. 22.....	6,016	4,572	1,324	1,000	75	29	84
Jan. 27.....	3,384	2,513	800	547	68	24	..
Feb. 4.....	1,932	1,369	466	335	72	29	..
March 15.....	836	648	175	120	66	13	..

* The iodine number represents the number of milligrams of iodine absorbed by 100 mg. of blood fatty acids.

1929, when the boy was 7.8 years old. Treatment with diet and insulin was initiated in 1929; but apparently the control of the diabetic condition was poor, as the boy was in diabetic coma three times. He had not been well and had been out of school since March 1933.

On admission the patient exhibited a moderate degree of Kussmaul breathing and was frail and cachectic. The urine contained 3.6 per cent of sugar and gave a 4 plus reaction for aceto-acetic acid with ferric chloride. The blood sugar value was 0.26 Gm. per hundred cubic centimeters, and the carbon dioxide-combining power of the blood plasma was 13 volumes per cent. With additional insulin the glycosuria and acidosis were quickly brought under control.

The initial sample of blood showed evidence of hyperlipemia, and ophthalmoscopic examination revealed a moderate degree of lipaemia retinalis. The picture was by no means as striking as that in the first boy. However, Dr. J. H. Waite noted at the time that the diagnosis of lipaemia retinalis was unmistakable when the smaller branches were inspected. They appeared flat, and the contents were creamy, with a small central case of red. The larger vessels presented a somewhat changed color and a prominent reflex stripe.

The course was most satisfactory, and in the first ten days in the hospital the patient gained more than 11 pounds (5 Kg.). He was ready for discharge on

February 6, but he fell on some steps and fractured the left humerus. Consequently, he remained in the hospital until March 3, when he was discharged on a diet containing 198 Gm. of carbohydrate, 97 Gm. of protein and 84 Gm. of fat. The dosage of insulin was placed at 16 units before breakfast, 6 before lunch and 16 before supper. The patient was seen at frequent intervals after discharge and on December 1 was in good general condition, with the diabetes fairly well controlled on a diet of 213 Gm. of carbohydrate, 105 Gm. of protein and 103 Gm. of fat, with 30 units of insulin daily. Since January 17 his weight (dressed) had increased from 56¼ to 91¼ pounds (25.4 to 41.3 Kg.).

In table 2 are recorded the results of six analyses of the blood of this patient at intervals from January 17 to July 26. Hyperlipemia, although not as striking as in the first boy, was marked, the total lipid content amounting to over 7.5 per cent. In this case also the greatest increase occurred in the fatty acids; next in order of increase was the free cholesterol, then the cholesterol esters and lastly the phospholipins. That the greatest increase in the fatty acids occurred in the saturated fatty acids is shown by the iodine numbers obtained before and after treatment.

TABLE 2.—*Summary of the Blood Fat Values in Case 9*

Date and Time	Total Lipid, Mg. per 100 Cc.	Fatty Acids, Mg. per 100 Cc.	Total Cholesterol, Mg. per 100 Cc.	Cholesterol Esters, Mg. per 100 Cc.	Cholesterol Ester-Total Cholesterol Ratio, per Cent	Phospholipin Phosphorus, Mg. per 100 Cc.	Iodine Number
Jan. 17, 11 p.m.....	7,530	6,748	787	490	62	33	76
Jan. 18 (fasting).....	3,971	3,201	675	400	59	24	..
Jan. 18, 11:30 a.m.....	2,548	1,907	580	295	51	22	..
Jan. 20.....	1,190	757	400	210	52	13	100
April 4.....	605	437	154	118	67	11	...
July 26.....	569	358	193	141	73	10	118

On January 17, the iodine number was found to be 76, and on July 26, 118 mg. of iodine was absorbed by 100 mg. of fatty acids.

CHEMICAL METHODS

The chemical methods employed were the oxidation method of Bloor [2] for determining the total lipid content and his colorimetric method for determining the total cholesterol content, with the slight modifications of technic previously outlined: [3] the Bloor-Knudson [4] procedure for determining the value of the cholesterol esters; the Fiske-Subbarow [5] method for determining the phospholipin content, and the Yasuda [6] modification (microdetermination) of the pyridine-dibromide method of obtaining the iodine numbers. The value of the fatty acids was calculated from the values obtained for total lipid and for total cholesterol according to the Bloor formula.

2. Bloor, W. R.: J. Biol. Chem. **77**:53 (April) 1928.

3. Marble, A.; Field, M. E.; Drinker, C. K., and Smith, R. M.: Am. J. Physiol. **109**:467 (Sept.) 1934.

4. Bloor, W. R., and Knudson, A.: J. Biol. Chem. **27**:107, 1916.

5. Fiske, C. H., and Subbarow, Y.: Unpublished method.

6. Yasuda, M.: J. Biol. Chem. **94**:401 (Dec.) 1931.

COMMENT

Marked Initial Fall in the Blood Fat Value.—These cases are instructive in demonstrating the degree to which hyperlipemia may develop, the rate at which values fall to normal and the relative changes in the several lipid elements. With the institution of treatment the initial decrease in the blood fat content is precipitous, but after a few days return to normal occurs more slowly. Although in our two cases the amount of fat which disappeared from the blood stream within the first hours of treatment was not as large as in the remarkable case described by Rabinowitch [7] in 1928, the quantity was sufficiently great to stimulate speculation as to the manner of the disappearance. Thus in the first case the value for total lipid fell initially from 14.1 to 9 per cent in about forty hours. If it is assumed that in that boy, weighing 48.4 Kg., there was 3.7 liters of blood, then in the forty hours about 189 Gm., or roughly 6¼ ounces of total lipid was lost. In the second case there was a fall of about 5 per cent in the total lipid content of the blood in the first twelve hours. If it is assumed that in that boy, weighing 25 Kg., there was 1.8 liters of blood, then 90 Gm., or 3 ounces, of fat was lost from the blood stream in twelve hours.

It is of interest in this connection to call attention to the case of Mrs. T. S. (case 7, table 3), who died in a diabetic coma on Dec. 10, 1930, at the age of 28. On her final admission to the hospital the blood sugar content was 0.37 Gm. per hundred cubic centimeters, and the carbon dioxide-combining power of the blood plasma was 3 volumes per cent. The plasma appeared creamy and on analysis was found to contain 19.864 Gm. of total lipid and 1.416 Gm. of total cholesterol per hundred cubic centimeters (the blood was drawn at 11:30 a. m. on December 9). With energetic treatment, which included large doses of insulin, by 11:45 a. m. on December 10 the total lipid value had fallen to 8.26 Gm. per hundred cubic centimeters and the total cholesterol value to 0.736 Gm. per hundred cubic centimeters. Thus in twenty-four hours the total fat content fell from 19.86 to 8.26 per cent, a decrease of 11.6 per cent. Allowing for 4 liters of blood in the patient's body, it is estimated that 464 Gm., or roughly 1 pound, of fat disappeared from the blood stream in one day. The patient died about three hours after the drawing of the second sample of blood.

Rabinowitch quoted Bloor as suggesting that the sharp initial decrease in the blood fat value, such as that seen in these cases, may be due to changes in the permeability of the tissues to fat. The amount of fat which disappears is far too large to be accounted for by oxidation; hence it must be stored. We [8] have shown (with Prof. C. K. Drinker and Dr. M. E. Field) that in the normal dog there probably exists a slight but definite permeability of the blood capillaries to fat, and it is reasonable to suppose that the degree of permeability may at times be increased.

7. Rabinowitch, I. M.: Am. J. M. Sc. **176**:489 (Oct.) 1928.

Relative Changes in the Lipid Fractions.—Long ago Joslin, Bloor and Gray [8] showed that in diabetic patients the severity of the disease is reflected in a substantial increase in the value of all the blood lipids. Thus, the values for total fatty acids in the plasma of fifty-five patients with severe diabetes were found to be three and one-fourth times, those for the total cholesterol two and one-fourth times and those for lecithin (phospholipins) twice, the values found in nineteen normal persons. Values even more closely comparable to those reported in our two cases were observed by Bloor,[9] however, when he studied at frequent intervals the lipoid constituents of a patient with severe diabetes who had broken his dietary regimen and in whom extreme hyperlipemia had risen acutely. One sample of blood showed fatty acid, cholesterol and lecithin (plasma) values which were respectively twenty-eight, nine and five times normal values.

Our studies, in agreement with those of others, indicate that decreases (and, by inference, increases) occur first and most rapidly in the "fat" element (as shown by the values of the total fatty acids). Next in order occur changes in the phospholipins and in the cholesterol content. Changes in the cholesterol content occur slowly and over relatively long periods. The better control of the diabetic condition that is possible now that insulin is available makes it possible in most instances to secure in time a normal blood cholesterol value.

Hyperlipemia and Acidosis.—It is interesting to speculate as to why in certain rare cases, like those reported here, the blood fat value rises to extremely high levels without an accompanying acidosis of comparable degree. Although in the average case of diabetic coma the blood fat and cholesterol values are above normal, the lipid values by no means parallel the degree of acidosis. Indeed, in a study of approximately five thousand determinations of cholesterol on a group of about two thousand diabetic patients, Joslin and Hunt [10] found that forty-one, or almost two thirds, of sixty-four values above 400 mg. per hundred cubic centimeters of blood were for patients who were not in a state of acidosis. It is common knowledge that in patients in diabetic coma the blood cholesterol and fat values may be normal. Consequently, the disordered mechanism which results in acidosis does not necessarily cause an increase in the blood fat, nor is the reverse true.

Level of Blood Fat Versus Lipaemia Retinalis.—In our two cases we did not note with accuracy the level of blood fat at which the lipaemia retinalis disappeared. This has, however, been done by other workers.

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8. Joslin, E. P.; Bloor, W. R., and Gray, H.: The Blood Lipoids in Diabetes, J. A. M. A. **69**:375 (Aug. 4) 1917.

9. Bloor, W. R.: J. Biol. Chem. **49**:201 (Nov.) 1921.

10. Joslin, E. P., and Hunt, H. M., in Joslin, E. P.: Treatment of Diabetes Mellitus, ed. 5, Philadelphia, Lea & Febiger, 1935.

Lepard [11] reported a case of diabetes with lipaemia retinalis in which determinations of the total blood fat were carried out over a period of almost three months. When the patient was first seen the value for total lipid was 14.168 per cent. With the institution of diabetic treatment the lipaemia retinalis disappeared in nine days, at which time the value for blood lipids was 2.709 per cent. In subsequent studies lipaemia retinalis was observed when the value for blood fats rose approximately above 4.25 per cent and disappeared when it fell below 2.8 per cent.

In the case reported by McKee and Rabinowitch [12] the fundi did not appear perfectly normal until the blood fat value had decreased to 1.13 per cent. That is to be contrasted with the observation of Jaffe and Schonfeld,[1] who stated that in their case (the blood fat content was 21.7 per cent on the third day after the patient's admission to the hospital) the fundus was normal when the value of the total blood lipids was 16.3 per cent. Intermediate values were reported by Parker and Culler,[13] who stated that lipaemia retinalis appears when the value of the blood fat rises above approximately 3.5 per cent and disappears when it falls below 2.5 per cent.

Obviously, there is considerable variation from case to case. In addition, it is well known that the blood fat content may be several times the normal value without the appearance of lipaemia retinalis. It has been suggested that the physical state of the fat is probably a factor. In this connection it is interesting to recall Bloor's case, that of a diabetic patient presumably without lipaemia retinalis,[9] in which the plasma was clear when the value for total fat was 4.35 Gm. per hundred cubic centimeters and that for total cholesterol was 1.37 Gm. per hundred cubic centimeters.

Additional Clinical Features.—Since Jaffe and Schonfeld [1] published an account of their case of lipaemia retinalis together with a review of the forty cases (other than their own) reported in the literature, no further reports other than those from our own clinic (that of Dr. E. P. Joslin and his associates) have come to our attention. Dr. Howard F. Root [14] has elsewhere briefly summarized the reports of the cases from our clinic, which now total nine, including the two described in this paper, and two others previously reported (cases 2 and 4 in table 3).[15] The total number of cases that have been reported in the literature now becomes forty-eight. Table 3 gives the data for our nine cases, which

11. Lepard, C. W.: Am. J. Ophth. **16**:12 (Jan.) 1933.

12. McKee, S. H., and Rabinowitch, I. M.: Canad. M. A. J. **25**:530 (Nov.) 1931.

13. Parker, W. R., and Culler, A. M.: Am. J. Ophth. **13**:573 (July) 1930.

14. Root, H. F., in Joslin, E. P.: Treatment of Diabetes Mellitus, ed. 5, Philadelphia, Lea & Febiger, 1935.

15. Gray, H., and Root, H. F.: Lipemia Retinalis, J. A. M. A. **80**:995 (April 7) 1923.

TABLE 3.—*Data on Nine Cases of Lipaemia Retinalis in Diabetic Patients (Experience of Dr. Elliott P. Joslin and Associates)*

No.	Sex	Age at Time of Lipaemia Retinalis, Years	Urine (Admission Specimen)		Blood				Alveolar Carbon Dioxide Tension, Mm. Mercury	Level of Blood Fat at Which Lipaemia Retinalis Was No Longer Detected, per Cent	Duration of Diabetes at Time of Lipaemia Retinalis, Years	Age at Death, Years	Duration of Life Since Lipaemia Retinalis Was Noted, Years		Cause of Death	Comment
			Sugar, per Cent	Aceto-acetic Acid	Sugar,* per Cent	Total Fat, per Cent	Cholesterol, Mg. per 100 Cc.	Carbon Dioxide-Combining Power, Vol. per Cent					Living Patients	Fatal Cases		
1	M	24.5	4.6	++++	0.31 F	.....	...	..	46	....	3.4	....	12.0	...		Xanthomatosis
2†	F	51.8	6.5	+++	0.31 F	5.120	...	..	31	....	1.1	52.3	....	0.5	Coma	
3	M	39.8	4.0	+++	0.13 F	.....	...	..	..	....	10.0	51.3	....	11.6	Coronary thrombosis	Xanthomatosis
4	M	36.5	5.8	++++	0.29	6.300	...	..	34	2.95	0.5	....	12.2	...		
5	M	28.3	7.0	++	0.25 F	.....	882	..	..	....	1.3	30.3	....	2.0	Coma	
6	F	41.8	3.3	0	0.22	.....	768	..	..	0.64‡	8.7	....	0.7	...		Xanthomatosis
7	F	27.7	3.7	++++	0.37	19.864	1,416	3	..	....	3.8	27.7	...	0.0	Coma	
8	M	16.7	7.4	++++	0.25	14.103	1,596	22	..	....	2.1	....	1.2	...		Xanthomatosis
9	M	12.7	3.6	++++	0.26	7.530	787	13	..	....	5.0	....	1.3	...		
Averages		31.1	4.4		0.27						4.0	40.4	5.5	3.5		

* Blood was taken at various times during the day except when marked F, which represents a fasting value.

† The laboratory data are those of May 23, 1921 (on hospital admission), when the note was made that the plasma was creamy. Analyses of blood fat on May 31 and June 6 showed 2.54 and 2.2 per cent blood fat, respectively. Presumably lipaemia retinalis was present on May 23, although no note of an ophthalmoscopic examination was made until June 13, when lipaemia retinalis was noted; on that date the blood fat was 4.24 per cent, and the urine had been free from diacetic acid and essentially free from sugar for two weeks.

‡ Cholesterol.

represent the only instances of lipemia retinalis recognized in approximately eleven thousand cases of true diabetes.

In this group there were six males and three females. The average age was 31.1 years, and the average duration of diabetes at the time the lipaemia retinalis was noted was four years. Four of the patients are dead. One died during the illness in which the lipaemia retinalis was noted, and the others died one-half, two and eleven and six-tenths years, respectively, afterward. The first three (cases 7, 2 and 5) died in diabetic coma and the fourth (case 3) of coronary thrombosis. For the five patients still living, the duration of life since the appearance of lipaemia retinalis has been seven-tenths, one and one-fifth, one and three-tenths, twelve and twelve and one-fifth years, respectively (to April 1935). Thus, although gross hyperlipemia indicates the presence of poorly controlled diabetes, the picture does not necessarily imply that the prognosis is unfavorable.

In this group of nine patients there was one (case 6) in whom lipemia retinalis was noted when acidosis, as judged by the ferric chloride test of the urine, was absent. It is possible that in the preceding days or weeks acidosis had been present. No data are available as to that period, but the situation may have been the same as in case 2 (see table 3 and the relevant footnote), in which lipaemia retinalis was not recognized, although it was undoubtedly present, until several days after the disappearance of acidosis. The highest value for total lipid was obtained in case 7, already described (19.86 per cent). In case 4 it was noted that lipaemia retinalis could no longer be detected when the total blood fat content had fallen to 2.95 per cent. It is noteworthy that four of the patients showed xanthomas of the skin.

Parker and Culler [13] in 1930 summarized the data concerning the thirty-eight cases they found reported in the literature. Thirty, or 86 per cent, of the thirty-five patients whose sex was recorded were males. The average age of the thirty-five patients for whom this fact was recorded was 25 years. The highest percentage of fat noted was that reported by Chase,[16] for whose patient the value of 48 per cent was obtained by the Babcock method. The next highest value was that of 26 per cent for Köllner's patient.[17] All the cases reported in the literature occurred in diabetic patients except one, that of Wagener,[18] in which hyperlipemia with evanescent lipaemia retinalis was noted in a boy of 9 years with lymphatic leukemia who had received radium therapy. All but two of the thirty-seven patients with diabetes as noted by Parker and Culler showed evidence of acidosis, and the authors were of the opinion that even those patients were probably acidotic. They stated

16. Chase, L. A.: Canad. M. A. J. **17**:197 (Feb.) 1927.
17. Köllner, K.: Zentralbl. f. prakt. Augenh. **34**:212, 1910.
18. Wagener, H. P.: Am. J. Ophth. **5**:521 (July) 1922.

that diabetic patients "probably do not show lipemia retinalis unless they are in acidosis." This is probably a true statement if one qualifies it to include patients who have very recently been in a state of acidosis, recognizing thereby the fact that with the institution of treatment the hyperlipemia disappears more slowly than the acidosis.

SUMMARY

Detailed studies were made of the values for total lipids, fatty acids, total and ester cholesterol and phospholipins in cases of lipaemia retinalis occurring in two boys with severe diabetes which had been poorly controlled. The total lipid content of the blood was 14.1 per cent in the first case and 7.5 per cent in the second. By far the largest increase took place in the fatty acid fraction. Next in order of relative increase was the cholesterol and third the phospholipin fractions.

Data regarding the nine cases of lipaemia retinalis recognized in this clinic are briefly summarized. The series includes a case in which the total fat content was 19.86 per cent.

Lipaemia retinalis occurs almost exclusively in diabetic subjects. It is most common in young adults and in males. It occurs usually, if not exclusively, in patients who are acidotic or who have recently been acidotic, but it does not parallel the degree of acidosis and may persist after acidosis has disappeared. It does not necessarily indicate a poor prognosis; two of our nine patients have lived for twelve years or more since the illness during which hyperlipemia was noted.

INTRACAPSULAR EXTRACTION OF CATARACT IN THE AVERAGE PRACTICE

REPORT OF ONE HUNDRED CASES IN WHICH VERHOEFF'S METHOD WAS USED

S. JUDD BEACH, M.D.
AND
W. R. McADAMS, M.D.
PORTLAND, ME.

Little has been written of the results of the extraction of cataracts in the capsule at the hands of operators outside the major clinics. We are therefore reporting on 100 consecutive operations from our practice. Many inexperienced operators have been discouraged from attempting intracapsular delivery because of the common understanding that it is too hazardous for use by men without unlimited material. Statements to this effect passed without comment as recently as the last meeting of this section. Furthermore, a number of careful analyses [1] have appeared, comparing the results of intracapsular extraction with those of capsulotomy performed by the same surgeons, which rather justify continuing with the orthodox technic. Unfortunately there is a considerable group of cases for which it is unsuited. These are, of course, the cases of immature cataracts. For patients thus incapacitated, only the intracapsular operation has general approval. It was for them that we finally undertook the operation. The result was so satisfactory that we have adopted the method as a routine practice.

This series, therefore, unlike many previously reported, is not restricted to cases selected as especially suited to intracapsular extraction but includes some in which this method is usually avoided. It is proper to consider this in estimating our results.

The technic followed is essentially that recommended by Verhoeff at the 1927 meeting of the American Ophthalmological Association. The corneoscleroconjunctival suture, described by him at the same meeting, was used invariably. It will be remembered that he advocated extracting the lens without tumbling, dislocating it by combined pressure and traction. The pressure is made on the cornea with the back of a strabismus

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Read before the Section on Ophthalmology at the Eighty-Sixth Annual Session of the American Medical Association, Atlantic City, N. J., June 14, 1935.

1. Parker, W. R.: Results of Cataract Extraction by the Simple, the Combined and the Intracapsular Methods, Arch. Ophth. **12**:128 (July) 1934. Gradle, H. S.: Intracapsular Versus Extracapsular Extraction of Cataracts, Am. J. Ophth. **17**:497 (June) 1934.

hook; the traction on the upper margin of the lens, by means of a special forceps. Verhoeff reasons that by this procedure the capsule is grasped at the thickest part, the equator, where rupture is least likely and where it can be seized again if torn; that loss of vitreous can be prevented by pressing the cornea against the lens and the lens against the posterior lip of the wound, and that after tying the suture, various manipulations can be performed with a minimum of risk. Without going into detail regarding this now well known method, we have, as anticipated, found it admirably adapted to the average practice. It does not require complicated apparatus, yet it is especially well safeguarded against the two most dreaded accidents, loss of vitreous and rupture of the capsule.

Of the refinements recommended in preparation for intra-ocular operation, we have adopted as a routine the administration of a hypnotic the night and morning preceding the operation, block of the orbicularis muscle with procaine hydrochloride and subconjunctival injection of procaine hydrochloride followed by a deep injection along the superior rectus muscle. A trained assistant is often urged as being indispensable for performing the intracapsular operation. Such an arrangement, of course, facilitates any operation, and our earlier operations were performed with such assistance. It has turned out, however, that most of the operations in this series had to be done by one of us (W. R. M.), with the aid of a nurse, intern or consultant. While sometimes the work may have been slightly slower on this account, no difficulties were encountered that could be attributed to want of special assistance. We are not, therefore, convinced that lack of an operating team need prevent any one from adopting this operation.

Without attempting to generalize from so few as 100 operations, we may say that our series proved to be as free from mishaps as the average reported from the larger clinics and freer than many.

VISUAL RESULTS

From deference to custom we are reporting our results in terms of central vision. Though an unsafe standard for evaluating the results of an operation for removal of cataract, the final acuity of vision has significance. Several of the patients showed defects in the field or had a history of loss of central vision from disorders recognized before operation and verified subsequently. We did not refuse to operate on such patients provided they showed promise of improvement and did not cherish unreasonable hopes. Usually they profited by being able to get about independently after having been obliged to await the pleasure of an attendant. This policy is open to the criticism that persons who do not regain reading vision may be dissatisfied and deter others from seeking relief. Even including such cases, our results show 84 per cent with central vision of 6/9 or better. If we may deduct the 5 patients

whose central vision was known before operation to be hopeless, 88.5 per cent of the 95 remaining patients had central vision of 6/9 or better, and 35 of these, or 37 per cent, had 6/6 or 6/4. Taken for what they are worth, these figures compare comfortably with those from the larger institutions.

CAUSES OF VISION LESS THAN 6/9

The impairment in the remainder in most instances antedated the operation. Of 4 with vision of 6/12, 2 had preoperative injuries and the other 2, old circulatory changes. Two with vision of 6/15 had had uveitis. There were also 2 with vision of 6/30. One had had atrophy of the optic nerve, and the other had opacities of the vitreous. Whether the opacities followed the operation or had been there previously cannot be determined. As there was no loss of vitreous, the opacities can hardly be attributed to the extraction in the capsule. In 3 cases alone poor vision was due to causes arising during or after operation. In 1 a massive nasopharyngeal infection developed, which extended to the conjunctival sac. Liquefaction of the wound permitted invasion of the eyeball and panophthalmitis. In another, after a slow convalescence, an abscess developed in the vitreous, apparently from endogenous infection. In these cases a capsulotomy operation would have been a detriment rather than a benefit. In the final case the patient reopened the wound by poking under the dressing with her finger. A large amount of vitreous escaped during the operation for repair, so that in spite of excellent vision at the time of discharge, detachment gradually developed, leaving only perception of light. In this case an intact posterior capsule might have given some added protection.

Complications from all sources were as follows:

		Cases	Percentage
Preoperative			
Detachment		1	..
Atrophy of optic nerve		3	..
Retinal hemorrhage		2	..
Chorioretinitis		3	..
Posterior synechia		7	..
Subluxated lens		1	..
Infected tear sac		2	..
Rosacea keratitis		2	..
Sydenham's chorea		1	..
Operative			
Loss of vitreous		..	7
Rupture of capsule		..	12
Mature	7		
Immature	5		
Ruptured capsules totally removed		..	7
Mature	6		
Immature	1		
Lenses delivered in capsule		..	88
Lenses and capsules delivered		..	95
Ruptured capsules not delivered		..	5
Postoperative			
Prolapsed iris		4	
Detached retina		2	
With recovery	1		
With light perception	1		
Abscess of vitreous		1	
Panophthalmitis		1	
Cyclitis with recovery		2	
Hyphema with recovery		5	

Prolapse of the iris was due in 1 case to massive edema of the lids and conjunctiva of a patient sensitive to procaine. In the other 3 it was the result of the patients rubbing or striking the eye. The hyphema amounted only to a small hemorrhage in the anterior chamber, which was absorbed. In 2 cases it was noted the day following the removal of the stitch. In general we were impressed, like others using intracapsular delivery, by the uninterrupted and comfortable recovery. Our patients were out of bed the second day, and many were out of the hospital in a week.

It is more the relatively small incidence of loss of vitreous and rupture of the capsule, however, that recommends this technic as being adapted to operators with average opportunities. The capsule failed to come out in only 5 cases. The loss of vitreous in the 7 cases in which it occurred was trifling, rarely more than a drop or two.

We cannot discuss other methods, such as tumbling and suction, beyond remarking that this method is likely to seem less formidable to the beginner. Not only is expensive and complicated apparatus not required but the capsule forceps is used, with which the surgeon is somewhat familiar, the lens is delivered head-on, as is natural, and a stitch is employed that gives a great sense of security. Greenwood and Grossman,[2] reviewing 1,343 operations performed by this method, claimed that vitreous is more easily controlled than by any other technic, and that the loss is no more than by capsulotomy. Yet we would not be understood as recommending the indiscriminate adoption of extraction in capsule. It is no operation for the surgeon who is prone to hard luck with his capsulotomy technic.

Yet, on the other hand, capsulotomy has no such margin of safety as seems to be assumed, and is far from being suitable for the bungler. Whatever moderate advantage it may have is likely to be forfeited by disasters threatening the convalescence. Capsulotomy is not suited to the removal of immature cataracts, and as the advantages of intracapsular delivery become known fewer cataracts will be allowed to develop to maturity.

CONCLUSION

Experience persuades us that the technic is suited not only to the requirements of the large clinic but also to the operator with average opportunities. Such an operator is justified in attempting it provided he is successful with the classic operation. In choosing between the methods, the danger of a convalescence complicated by remains of lens must in each individual case be weighed against a delivery requiring somewhat greater dexterity.

2. Greenwood and Grossman: Tr. Am. Ophth. Soc., to be published.

ABSTRACT OF DISCUSSION

DR. WALTER R. PARKER, Detroit: It is difficult to compare the results of different operators because of the difference in technic. For instance, it is not fair to compare the results of intracapsular extraction and those of combined operation, if in the latter the anterior chamber has not been irrigated. The intracapsular operation is growing more popular in this country, and, generally speaking, better results are obtained with experience and refinement of instruments. It certainly is the operation of choice in cases of immature cataract. I have felt that improvement in my results from extraction of cataract would come through a more careful classification of the opacities, a study of the complications present and a careful selection of the type of operation that would best suit the individual case. It is interesting to note that posterior adhesions were present in 7 of the cases reported. It took me about twenty years to conclude that posterior adhesions were not necessarily a serious complication to extraction by capsulotomy, but I have never attempted an extraction in the capsule when posterior adhesions were present. I have always been of the opinion that no one type of operation was suited to all forms of cataract. If, however, the results reported can be maintained, I am willing to admit that I shall be forced to change my mind.

DR. JOHN GREEN, St. Louis: The intracapsular extraction of cataract has developed along two lines: the suction method and the combined traction and pressure method. It is interesting to note that with all available methods to choose from the majority of ophthalmic surgeons have adopted some form of traction combined with pressure.

Dr. Beach and Dr. McAdams have wisely selected a type of traction-pressure operation requiring gentle manipulations, and they have been rewarded with a loss of vitreous in only 7 of 100 unselected cases. I find myself in agreement with most of the points made by the authors. I prefer a retrobulbar injection of procaine hydrochloride. I regard it as of even greater importance than a deep injection of this drug into the superior rectus muscle. It is interesting to note the ever increasing tendency to employ some type of suture, whether of the corneoscleral or the strictly conjunctival type, to help seal the wound. This practice accords with my own experience. In this series I have been impressed with the few capsules that have ruptured and still more with the high percentage of removal of capsules after rupture. This speaks well for Verhoeff's technic. Operation on patients with stationary defects of the field and loss of central vision is, to my mind, entirely justifiable. When, however, progressive optic atrophy is a complicating factor, it is my opinion that operation should not be performed. Complication occurred in 1 case because of sensitiveness to procaine. Sensitiveness both to procaine and to cocaine is not rare. One refinement in technic is the determination of the reaction of the patient to these drugs administered by intradermal injection prior to operation. In 4 cases postoperative complications are directly attributable to rubbing or poking the operated eye. This brings up the question of adequate postoperative shielding. I recognize that no type of shield yet devised will protect the eye from maniacal violence on the part of the patient. Adequate shielding will, however, prevent most postoperative trauma. It is my practice

to protect the eye with an aluminum shield held on with a number of adhesive strips crossing at right angles. This affords adequate protection. The use of adhesive plaster is advisable, as any attempt to strip it off will induce pain, thus acting as a deterrent to further meddling.

DR. J. W. MILLETTE, Dayton, Ohio: Having had considerable experience in operative procedures for cataract I am convinced that there is no question as to the efficacy or the efficiency of intracapsular extraction. The method of procedure is a matter of choice of the operator. If he performs a considerable number of operations, he will soon develop a technic peculiarly his own, whether he delivers by external manipulation, by the use of forceps or by suction. Whether one form of extraction proves more difficult than the others is in great measure due to the mental attitude of the operator as well as to his peculiar adaptability to certain technical tendencies. Too much stress may have been laid on the difficulties of the intracapsular method, but one feature that seems to make its technic more difficult than capsulotomy is delivery of the lens, which, of course, is the one difference between the methods. This difference can be learned only by experience, and experience can be obtained only by operating on the human eye. The eyes of the pig, the cat and the dog are so essentially different that there is little help to be had from these sources. The human cadaver is the best source of practice for development of skill. I am of the opinion that any surgeon with sufficient skill to perform a capsulotomy successfully can operate successfully by an intracapsular method. However, I still think that one should perfect one's skill in a capsulotomy method before attempting any form of intracapsular extraction.

DR. FREDERICK H. VERHOEFF, Boston: The statistics presented by the authors and those presented by Dr. Grossman at the recent meeting of the American Ophthalmological Society are pleasing, because they show that this operation yields satisfactory results at the hands of inexperienced as well as of experienced operators. The results are as good or better than those reported by individual expert operators using other methods. When the patient is more than 50 years of age I employ this method, no matter what the type or stage of cataract or whether or not the eye is prominent. Only in patients below this age do I restrict its use. Operators employing other methods attempt to remove the lens with its capsule only in selected cases and usually set the age limit at 55 years. In all cases I now employ two corneoscleroconjunctival sutures inserted by the aid of the instrument that I devised for this purpose. With the sutures placed one to each side of the midpoint, I have never had postoperative prolapse of the iris or lost an eye from infection. As regards the question as to who is qualified to perform this operation, it seems to me that if an operator is not sufficiently skilful to undertake this procedure he should not perform any type of operation for cataract.

DR. WILLIAM R. MCADAMS, Portland, Maine: I have no intention of prolonging the deliberations beyond thanking those who have participated in the discussion, particularly Dr. Parker and Dr. Green, who have remained to the end to give the benefit of their experience.

THE STRUCTURE AND FUNCTIONS OF THE ANGLE OF THE ANTERIOR CHAMBER AND SCHLEMM'S CANAL

OTTO BARKAN, M.D.
SAN FRANCISCO

Whereas knowledge of the structure of the anterior segment of the eye has been greatly enlarged in recent years by slit-lamp studies of the living eye, the present knowledge of the structures of the angle of the anterior chamber is still based almost solely on information acquired from the classic method of anatomic dissection and microscopic section of dead tissue. Information obtained from a study of the angle of the living eye (gonioscopy) has, as yet, hardly been correlated with it. In spite of this rather indefinite correlation, steady progress has been made in the observations on the angle in the living eye since the angle was first seen by Trantas,[1] who introduced the term gonioscopy for this type of examination. In succeeding years the method was further developed by Fick,[2] Salzmann,[3] Koeppe,[4] Troncoso,[5] Ascher[6] and others, so that Troncoso, who popularized the term gonioscopy, stated in 1930 that it had passed the experimental stage and afforded a practical clinical method which should be incorporated in the routine examination of the eye. On the other hand, Trantas as late as 1928 quoted and endorsed the opinion of Koby, who, in referring to gonioscopy made with the aid of the microscope of Koeppe, stated that these methods will never be employed in current practice; that their clinical benefits have been very modest to date, and that in addition to requiring a very expensive instrumentarium one must employ a most willing and exceedingly cooperative patient. Similar arguments were used against slit-

Read before the Western Ophthalmological Society, Portland, Ore., May 24, 1935.

1. Trantas, A.: Ophtalmoscopie de la région ciliaire et rétrociliaire, Arch. d'opht. **27**:581, 1907.

2. Fick: Hydrodiaskop und Kontaktglass, Klin. Monatsbl. f. Augenh. **35**: 129, 1897.

3. Salzmann, M.: Die Ophthalmoskopie der Kammerbucht, Ztschr. f. Augenh. **31**:1, 1914.

4. Koeppe, L.: Das stereomikroskopische Bild des lebenden Kammerwinkels an der Nernstspaltlampe beim Glaukom, Klin. Monatsbl. f. Augenh. **65**:389, 1920.

5. Troncoso, M. U.: Gonioscopy and Its Clinical Applications, Am. J. Ophth. **8**:433, 1925.

6. Ascher: Zur Mikroskopie des lebenden Auges, Klin. Monatsbl. f. Augenh. **78**:628, 1927.

lamp microscopy and the use of the Gullstrand binocular ophthalmoscope a number of years ago. The validity of these arguments has been disproved by the universal adoption of these methods and the obtaining of appropriate equipment throughout the ophthalmologic world. I would endorse Troncoso's statement and disagree with Koby's; however, I concede to Koby that the installation of a proper gonioscopic method does entail considerable expense. At the meeting of the Pacific Coast Oto-Ophthalmological Society, my associates and I [7] recently described a new gonioscopic method which we believe to be superior to any method that has been attempted in this field.

With this method, and by means of some experiments, I have endeavored to establish exact correlation between the results of slit-lamp examination of the angle in the living eye and previous anatomic knowledge in order to rectify certain misinterpretations of the past and to clarify the terminology as a foundation before proceeding with clinical and pathologic investigations of this region. That there is still much confusion in the terminology of the structures of this region is apparent when, for example, one finds in Axenfeld's textbook that the same structures are given different names by various authors in the same book. Thus Peters in speaking of the pectinate ligament includes the whole meshwork of the angle (as do such authors as Herbert and Henderson in the English literature). Krückmann in the same book uses the term pectinate ligament to denote only the uveal portion of the meshwork.

It is not within the scope of this paper to do more than refer to the complete anatomic and embryologic studies of this region published by Salzmann,[8] Rochon-Duvigneaud,[9] Seefelder,[10] Wolfrum [11] and others. Virchow [12] described the great difference between the structure of the angle of the adult human eye (including primates) and that of the angle of the eye of other animals. The difference is so remarkable that experimental results on the outflow of intra-ocular fluid in animals can be applied to human beings only with great care. However, it has been

7. Barkan, Otto; Boyle, S. F., and Maisler, S.: On the Genesis of Glaucoma: An Improved Method Based on Slit Lamp Microscopy of the Angle of the Anterior Chamber, Tr. Pacific Coast Oto-Ophth. Soc., 1935, to be published.

8. Salzmann, M.: Die Ophthalmoskopie der Kammerbucht, Ztschr. f. Augenh. **34**:26, 1915.

9. Rochon-Duvigneaud: Recherches anatomiques sur l'angle de la chambre antérieure et le canal de Schlemm, Arch. d'opht. **12**:732, 1892.

10. Seefelder, in von Graefe, A., and Saemisch, E. T.: Handbuch der gesamten Augenheilkunde, Leipzig, Wilhelm Engelmann, 1910, vol. 1, p. 627.

11. Wolfrum: Arch. f. Ophth. **63**:430, 1906.

12. Virchow, in von Graefe, A., and Saemisch, E. T.: Handbuch der gesamten Augenheilkunde, Leipzig, Wilhelm Engelmann, 1905, vol. 1, p. 280.

shown that the difference does not exist during a certain period of fetal life but appears only during the process of later, or of extra-uterine, development. Thus the angle of a human eye the development of which has been stopped at a certain point or has progressed further in atypical fashion may show close similarity to the angle of the eye of an animal. Seefelder [10] claimed that this remarkable phylogenetic fact gains in significance in view of the fact that such human bulbi are apparently much more predisposed to glaucomatous conditions than normal ones and that this observation would therefore allow certain conclusions to be drawn concerning the circulatory-regulating mechanism of the eye. It has been definitely established that at a certain stage of development the space which later corresponds to the angle is occupied by a mesodermal reticulum. All mammals pass through this stage. The same mesoderm gives rise to the uveal meshwork, to the mesodermal part of the iris and to the pupillary membrane. In animals this meshwork becomes highly specialized and in various species develops into very different forms (ligamentum pectinatum). In man and in primates it does not, as a rule, differentiate beyond a rather primitive developmental stage, and most of the primitive uveal meshwork retrogresses. Thus the open angle of the human eye is formed, which shows only occasionally some iris processes traversing the angle as vestigial phylogenetic and ontogenetic remnants of that structure which is the pectinate ligament in animals. These processes are rarely preserved or seen in anatomic sections. Through the courtesy of Professor Kubik, of Prague, who called attention to them in Heidelberg in 1920, I am able to show a photomicrograph of one in figure 1. However, the gonioscopic studies show them to be not only generally present but frequently also in very considerable amount so that in exceptional cases the appearance of the angle of the human eye may approximate that of the eye of the animal.

It was unfortunate that Hueck [13] in 1839 first investigated this structure in ungulates (horse), since in the horse it varies greatly from similar structures in primates and in man. He called it the pectinate ligament because of its resemblance to a comb (pecten). Fontana,[14] in another ungulate (cow), described the spaces underneath these structures as a canal; hence the lingering of the name spaces of Fontana for the spaces in this region. In the human fetus similar structures exist until the sixth month, and then undergo atrophy and are hardly to be observed in the adult (Duke-Elder).[15] (I shall show later that this view requires considerable revision.) In the adult human eye by far

13. Hueck, cited by Virchow.[12]

14. Fontana, cited by Duke-Elder.[15]

15. Duke-Elder, W. S.: Text-Book of Ophthalmology, St. Louis, C. V. Mosby Company, 1933, vol. 1, p. 361.

the major part of the meshwork of the angle is made up of scleral meshwork (Virchow; sclerocorneal trabecula of Rochon-Duvigneaud). The uveal portion of the meshwork is represented by a vestigial remnant of delicate trabeculae which follow a bow-shaped course around the angle of the anterior chamber on the inner surface of the sclerocorneal portion (Duke-Elder).[16]

A study of, and an attempt to recognize, these and other structures in the angle in the human living eye have been made by workers with gonioscopic methods in the past. After examination of several hundreds of eyes by my method of gonioscopy I wish to refer to and demonstrate on a model certain appearances and facts that I feel have not yet been elucidated.

STRUCTURE

On the corneal side the entrance to the angle is formed by the anterior border ring of Schwalbe, a prominence which was found to be much more pronounced than is apparent in anatomic sections and which varies considerably in different eyes. In its lower third granules of pigment often settle on this ring. This physiologic accumulation increases with age and is more pronounced in brown eyes but no more so in the oriental (Japanese), as has been suggested in the literature in relation to certain theories of glaucoma, than in the brown eyes of Caucasians. From the ring of Schwalbe the wall of the angle proceeds obliquely and is therefore seen much foreshortened. By adjusting the position of the observer and the eye of the subject as well as shifting the contact glass, it is possible to obtain an almost frontal view of the wall as well as of other parts of the angle. The next definite landmark is a white line, which has been regarded as the scleral spur, or the posterior annular ring. This can now be proved to be the case. Between these two landmarks the individual fibers of the sclerocorneal trabecula can be seen to course in meridional and circular directions. These fibers are sometimes more definitely delineated with advancing years, when stained with pigment, and in certain cases of a pathologic condition. Lying directly on this surface there can be seen a few very delicate branching trabeculae which are an extension of the anterior surface of the iris and which must represent that filamentous portion of the meshwork of the angle which anatomists describe as the uveal meshwork. If the iris is removed from the ciliary body in the wet specimen, the anatomist refers to that portion of the meshwork which remains connected to the ciliary body as the scleral mesh and the very thin portion remaining attached to the iris as the uveal meshwork.

16. Duke-Elder,[15] p. 86.

Teased preparations also show these fibers, as illustrated by Salzmann [17] and Duke-Elder.

From the white line (or spur) a smooth glistening surface (where there are no iris processes interposed between it and the observer) sweeps in an arc to form the sinus of the angle and to continue as the anterior surface of the iris. The aforementioned very few delicate uveal threads can be distinguished as forming part of this surface. They appear to be no more than continuations of individual stromal elements

Fig. 1.—Photomicrograph of the normal angle of the human eye. *A* indicates Schlemm's canal; *B*, the sclerocorneal trabecula, and *C*, the iris process traversing the angle.

of the iris. This region of the angle is, however, subject to great individual changes, for its appearance depends on the presence, absence or amount of iris processes (the vestigial remnants of the pectinate ligament of animals which we have found to be represented in the

17. Salzmann, M.: Anatomie und Histologie des menschlichen Augapfels im Normalzustande, seine Entwicklung und sein Altern, Leipzig, Franz Deuticke, 1912.

ontogenetic development of man) which traverse it. These processes vary greatly in number and extent in different persons, as they may also vary in different parts of the circumference in the same person. They are of the same general color as the stroma of the iris but usually are lighter, appearing gray or white in blue irides and yellowish or light brown in dark ones. Individual processes, however, may be darker, while others may have collected granules of pigment on their surfaces. They are most frequently seen traversing from the ciliary region of the iris to the white line, or spur, across that portion of the root of the iris which corresponds to the anterior surface of the ciliary body. In such cases the ciliary body is veiled by these processes. The iris thus appears to attach directly by means of the iris processes to the white

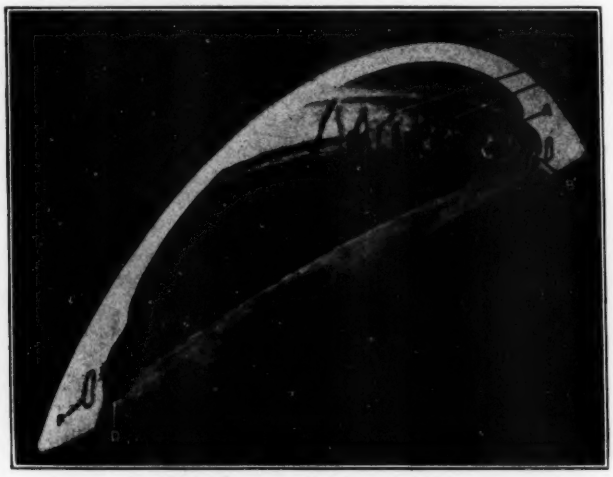


Fig. 2.—Photograph of a model showing gonioscopic appearance. *A* indicates the internal annular ring of Schwalbe; *B*, the scleral spur (white line); *C*, the sclerocorneal trabecula; *D*, the sinus of the angle; *E*, iris process, and *F*, Schlemm's canal. In our opinion the iris processes constitute the greatest part of what should be called the uveal meshwork. They represent the vestigial remnant of the pectinate ligaments in animals.

line with what appears to be a fringe of its own stroma. Where they are absent, the bottom of the sinus is seen to be formed by the ciliary body, which underneath its slightly glistening diaphanous surface covering has a somewhat granular appearance. It is of a slightly darker shade, approaching a light chocolate tint in both brown and blue eyes. The iris processes may take their origin from different levels of the iris root, or ciliary region of the iris, as they also insert at different heights on the wall of the angle (sclerocorneal trabecula), and even occasionally extend to the anterior border ring of Schwalbe. Their greatest number ordinarily insert not higher than the white line, but the

variety of their insertion and distribution is manifold. When they are highly developed they form a dense mesh, in different planes or receding rows greatly resembling the appearance of the pectinate ligament in animals—the pig, for example. On direct gonioscopic examination one is much impressed with the possibility that this structure may be identical with the pectinate ligament of animals. Its great diversity, due to the various degrees of retrogression or development of this vestigial remnant, and its important rôle in determining the configuration of the individual angle are also strikingly evident.

Schlemm's canal, which Salzmann and Troncoso believed to have identified in some cases as a faint grayish band anterior to the white line, I have observed distinctly in cases of pathologic conditions. In a previous article[7] it was shown that in many cases of simple glaucoma this part of the trabecula was stuffed with granules of pigment, thus forming a dark, sharply delineated band throughout

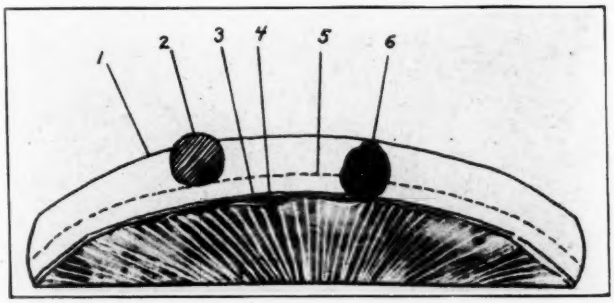


Fig. 3.—Diagram to show the location of the dermal suture and of the clump of pigment on the wall of the angle as determined gonioscopically: *1* indicates the anterior border ring of Schwalbe; *2*, the dermal suture; *3*, the ciliary body of the iris root; *4*, the white line (scleral spur); *5*, the anterior border of Schlemm's canal, and *6*, a clump of pigment.

the whole circumference of the angle. In cases in which, as a result of cyclodialysis, the spatula had scraped off the granules, an evenly stained brown band was seen in this location slightly external to or deeper than the surface of the trabecula. To establish further the location of the canal the following experiment was performed on the eye of a person who had been hanged:

With the eye still in situ the anterior chamber was perforated about 2 mm. behind the limbus with a hypodermic needle containing a thread of blue dermal suture. The needle was removed without loss of aqueous, and the suture was allowed to remain, projecting into the angle of the chamber. On gonioscopic examination of the eye the suture was seen to have perforated and was occupying the trabecular region between the anterior border ring of Schwalbe and the white line (fig. 3). At

some distance from the suture a large clump of pigment was discovered which occupied exactly the same region. When the eye was sectioned the anterior end of Schlemm's canal was found to have been struck and torn open by the needle. Furthermore, the sclerocorneal trabecula had been torn off from its anterior insertion (fig. 4).

Because of the location of the dermal suture, as seen gonioscopically, and the position of the track as seen in the section, there can be no doubt

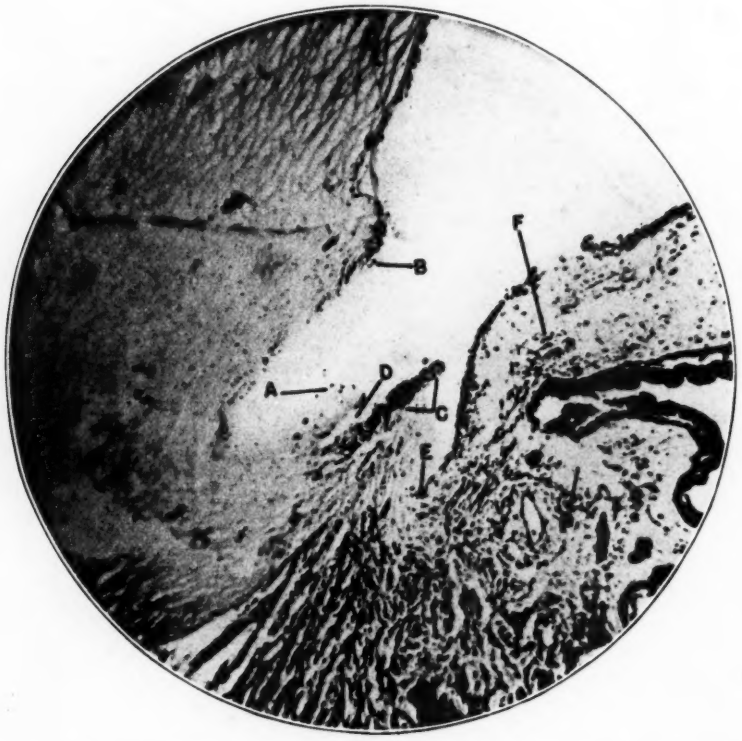


Fig. 4.—Photomicrograph of the angle of the anterior chamber. *A* indicates the track of the hypodermic needle and the dermal suture; *B*, torn anterior insertion of trabecula; *C*, sclerocorneal trabecula torn from its insertion; *D*, the lumen of Schlemm's canal (it is torn open anteriorly); *E*, the sinus of the angle; *F*, root of the iris, and *G*, the ciliary body.

that Schlemm's canal is situated just anterior to the white line and that our gonioscopic interpretations of this region are correct. This is further confirmed by using the clump of pigment as a gonioscopic landmark and checking its position. This can be seen in the sections (fig. 5).

In all normal eyes I have found the entrance to the angle to be narrower in the upper than in the lower part. It has here-

tofore been assumed to be of equal width throughout its circumference. One wonders what the functional significance of this fact may be and whether the greater width of the lower angle, combined with the influence of the hydrostatic pressure of a column of aqueous when the subject is in the upright position, may denote a greater filtration of aqueous from the lower angle and whether this is a causal factor in the diurnal variation of the intra-ocular pressure.

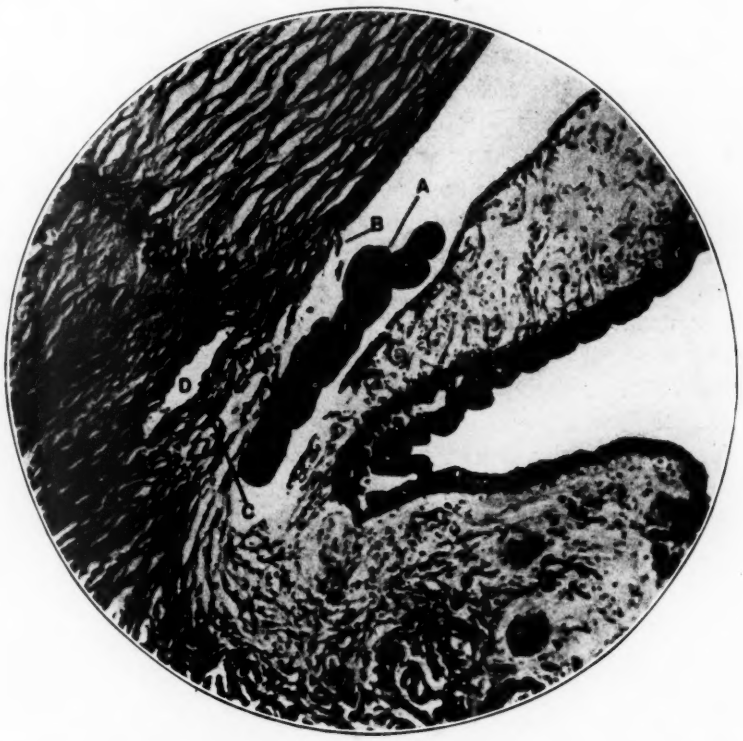


Fig. 5.—Photomicrograph of the angle of the same eye as shown in figure 4. *A* shows an anomalous clump of pigment; *B*, the anterior border ring of Schwalbe; *C*, the sclerocorneal trabecula, and *D*, Schlemm's canal.

I have not found the variable degree of development of the pectinate ligament (iris processes, or what in my opinion really constitutes the main part of the uveal meshwork) to have any functional significance under either physiologic or pathologic conditions. Contrary to previously expressed opinions, an abnormally developed pectinate ligament (iris processes) does not seem to predispose to glaucoma or be in any way correlated with it. It appears to be a vestigial remnant without functional significance, as is the persistent pupillary membrane of the iris.

FUNCTION

As to the function of Schlemm's canal, one can gather much information by observing the effects of its mechanical obstruction, as with iris tissue, lens débris or pigment, on the circulation of the intra-ocular fluid. One finds that in addition to the amount of obstruction which will determine the retention of a certain amount of intra-ocular fluid the rate of onset of the block is an important factor in causing increased intra-ocular pressure.[7] Thus the sudden onset of a small area of block may produce a comparatively high degree of intra-ocular hypertension when compared to the hypertension caused by a much larger area of block which has developed very gradually. The effect of obstruction of Schlemm's canal on the intra-ocular circulation must therefore be dependent largely on a reflex vasomotor mechanism.

It is logical, at this juncture, to point out the possible analogy between the known effects of blocking the venous circulation in the extremities, experimentally observed, and the effect of blocking Schlemm's canal. Is it not logical to regard Schlemm's canal, even though it usually contains lymph, as functionally part of the venous system of the eye, blocking of which will, as occurs in venous block in the extremities, activate a compensating reflex mechanism that increases local arterial pressure and transudation of fluid? The purpose of this mechanism supposedly would be to overcome the block and maintain the rate of circulation of intra-ocular fluid necessary for normal metabolic exchange. The significance of this mechanism in glaucoma will be dealt with in further publications.[7]

SUMMARY

The attempt has been made to correlate the structure of the angle of the anterior chamber as seen in the living eye with the anatomy of this region, to clarify the knowledge of the region and to correct certain errors in the terminology.

The angle of the anterior chamber has been found always to be narrower above and wider below.

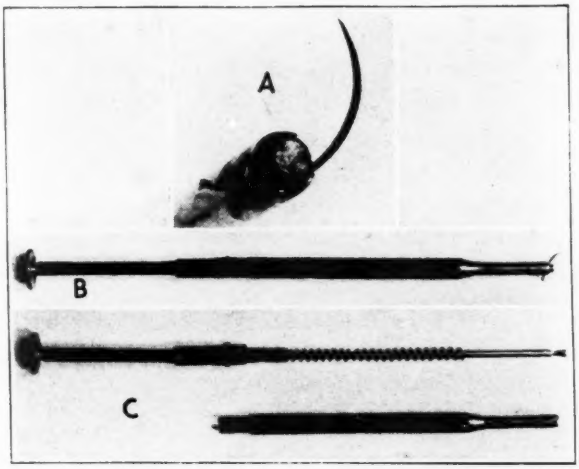
The exact location of Schlemm's canal in the gonioscopic picture has been established, and suggestions are made as to its physiologic and pathologic significance.

Clinical Notes

A NEW NEEDLE-HOLDER FOR OPHTHALMIC AND OTHER DELICATE SURGERY

F. H. Verhoeff, M.D., Boston

In suturing wounds in operations for cataract by the aid of the instrument recently described by me [1] I have been hampered by the lack of an entirely suitable needle-holder. The difficulty has been especially great when I operated on the left eye while standing behind the patient, owing to the hindrance of the latter's nose. A needle-holder that I have recently devised and constructed has greatly facilitated this particular



Photographs of the needle-holder. *A*, needle in grasp of the instrument; magnification, about 8/3. *B*, instrument, about two-thirds actual size. *C*, separate parts of the instrument.

operation and no doubt will be found of great value in many other delicate operations on the eye and in nasal, abdominal and plastic surgery. Although the instrument is exceedingly small at the working end, it holds the needle more firmly in position without danger of breaking it than any other needle-holder known to me. The instrument as at

From the Howe Laboratory of Ophthalmology, Harvard University, and the Massachusetts Eye and Ear Infirmary.

Read before the Section on Ophthalmology at the Eighty-Sixth Annual Session of the American Medical Association, Atlantic City, N. J., June 13, 1935.

1. Verhoeff, F. H.: A New Instrument for Simplifying the Insertion of Corneo-Sclero-Conjunctival Sutures in Operations for Cataract, Am. J. Ophth. **17**:53 (Jan.) 1934.

present constructed will hold any flat or triangular needle commonly used in ophthalmic surgery, either straight or curved. For special purposes it may be found advantageous to modify it in minor details. In the instrument is utilized a principle that, so far as I know, has not hitherto been employed for such a purpose, namely, the application of pressure to a needle by means of a cone and a spiral spring. The cone is at the end of a plunger which slides in a tube. At the end of the tube are notches into which the needle fits. The details of construction are sufficiently obvious from the illustrations. The needle can be held by the instrument either at a right angle or at an obtuse angle to the shaft. The latter hold is more convenient for general purposes and is especially advantageous for operations on the left eye. In fact, by supporting the needle-holder on the nose suturing the left eye is more easily accomplished than suturing the right eye.

After a little practice, placing the needle in the grasp of the instrument becomes a simple procedure. The needle should be held near the point by the thumb and first finger of the left hand and supported at the other end by the second finger. It is then brought into contact with the cone and into the notch desired, while the instrument is held in the right hand with the plunger pushed out. By pressure of the knob on the palm or little finger of the right hand the plunger is then released. The needle can be easily and instantly released by pushing out the plunger as described. A left-handed operator may require a special instrument with the arrangement of the notches reversed. The instrument is inferior to an ordinary needle-holder in only one respect, namely, that with it the needle cannot so readily be regrasped and pulled out of the tissue. But even when using an ordinary needle-holder I have usually pulled out the needle by means of fixation forceps or have had my assistant do so. The instrument can be sterilized in boiling water or in alcohol and can be easily taken apart for cleaning.

I have submitted a model of the instrument to V. Mueller & Co. of Chicago, who inform me that they are now ready to supply the instrument constructed of rustless steel throughout.

"WHITE RING" IN THE CORNEA

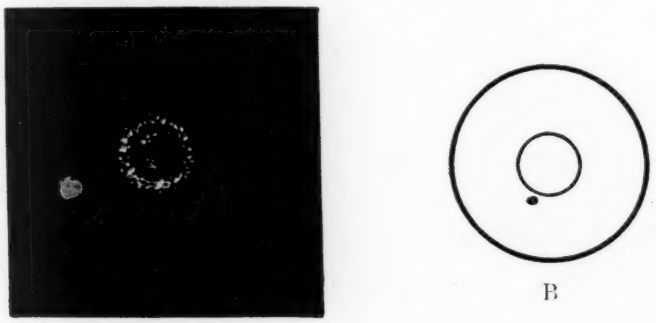
JOSEPH ZIPORKES, M.D., NEW YORK

This case is described because of the rarity of the condition. It is probable that white ring of the cornea may occur more frequently than is supposed, but that it is either overlooked or not reported.

The case was reported at the clinical conference of the Herman Knapp Memorial Eye Hospital, Jan. 17, 1935.

Mrs. R. V., aged 52, was first observed on April 12, 1935. She had been struck in the right eye with the edge of a plant one week before. Congestion and tearing had been present since that time. There was a minute abrasion of the cornea, staining with fluorescein, which healed within twenty-four hours. Below this abrasion was a ring slightly more than 0.25 mm. in diameter. With the slit lamp it was seen to be composed of discrete chalky-white dots. In one part of the ring a few dots were confluent, so that a thick line was formed. In the center were a number of similar dots. The corneal epithelium over the ring was smooth, and the dots did not stain with fluorescein. The iris, anterior chamber and fundus were normal. Vision was 20/30. The reactions to the Wassermann and Mantoux tests were negative. There was no diabetes. The blood pressure was normal. There had been no change in the appearance of the cornea since the time of examination. The left eye was normal.

Stallard [1] described a similar condition occurring in a boy of 17. There was no history of trauma. The ring was larger than that in the present case and was oval. The case reported by Mayou [2] was exactly



A B

A shows the appearance of the white ring in the cornea as seen with the slit lamp; *B*, the location of the ring.

similar to that of this patient. Ballantyne [3] described six cases and appended references to the literature.

Coats, who reported two cases in 1912 and 1913, thought that the condition was congenital. Mayou expressed the same opinion. In two of Ballantyne's cases chorioretinitis was present, and in one, glaucoma. He suggested that the ring may be drusen in Bowman's membrane, such as were described by Elschnig in 1899. These drusen undergo degenerative calcareous changes. Trauma does not play a rôle in the production of the ring, as trauma is frequent and this condition, as Vogt stated, is rare. Koeppe did not even mention it, and no case has been reported in the American literature.

1. Stallard, H. B.: "White Rings" in Cornea, Brit. J. Ophth. **18**:452 (Aug.) 1934.

2. Mayou, M. S.: "White Rings" in Cornea, Brit. J. Ophth. **17**:342 (June) 1933.

3. Ballantyne, A. J.: "White Rings" in Cornea, Brit. J. Ophth **17**:336 (June) 1933.

NOTE.—Another patient, J. O., a man aged 24, with a similar white ring in the cornea of the left eye, was observed at the Herman Knapp Memorial Eye Hospital on Aug. 31, 1935. He had a cinder removed from that eye four years before. Except for subacute conjunctivitis in both eyes, no pathologic condition was noted. Vision was normal.

CYCLOPIA

M. G. DER BRUCKE, M.D., BROOKLYN

Cyclopia, although mentioned in a Chaldean cuneiform tablet, is sufficiently rare to remain a human curiosity. This form of monstrosity has been readily produced experimentally. Various explanations have been propounded since Camille Dareste [1] stressed the theory of premature closure of the anterior end of the neural tube. It seems, however, that the theory devolved by Stockard,[2] as a result of his experimental work with toxic substances, is the more likely one.

It has been shown that the anlage for the eye is originally in the median plate. On the mere pricking of one or the other side of the central point the eye-forming material escapes and cyclopia develops. Stockard thought that the action of the magnesium salts, which he used in his experimental work, was that of an anesthetic, which did not allow the lateral separation of the optic bud. To prove this he used a 5 per cent solution of alcohol and other anesthetics and obtained the same results. Addition of dextrose and other nontoxic material failed to produce cyclopia. It was suggested that toxins in the mother's system help to produce monstrosities. It was shown that Bacillus pyocyaneus, the viruses of tetanus and hog cholera and products of hen tuberculosis injected into the chick embryo produced an enormous amount of monstrosities.

Stockard's theory, then, that cyclopia is a developmental defect, brought about by environmental change after cell mitosis has begun, is a likely one.

Hannover, in 1882, had collected one hundred and six instances. Since then there have appeared thirty more in the literature. We wish to add another to the growing number.

REPORT OF A CASE

R. B., aged 39 years, had been pregnant seven times. Five births were easy and occurred at full term. In one pregnancy spontaneous miscarriage occurred at four months. The last menstrual period was on Feb. 22, 1933; the expected date of delivery was November 29. On admission, on October 9, the patient gave birth by precipitate labor to a 7½ month premature male infant weighing 2 pounds and 14 ounces (1,304.06 Gm.). Respirations were shallow, and after one-half hour the child expired. During the current pregnancy the patient had occasional headaches, edema of the ankles and albumin in the urine (2 plus).

From the Department of Obstetrics, Coney Island Hospital.

1. Dareste, C.: Ann. d'ocul. **106**:171, 1891.

2. Stockard, C. R.: Am. J. Anat. **10**:369, 1910; **28**:115, 1921.

At autopsy on gross examination the external configuration of the neck, thorax, abdomen and extremities showed no abnormalities. The external genitalia and anus were intact. The testicles were not palpable in the scrotum. The head showed complete development of the scalp and the bones of the skull. The ears showed no abnormalities. The face showed a cylindric protuberance 1.5 cm. long and 1 cm. in diameter, arising from the midline from the inferior border of the forehead. This was covered with thick skin externally and mucosa internally. It presented an opening which led down to its base and ended blindly. It had a cartilaginous feel and on section was seen to be composed of three cylinders from within outward, of mucosa, cartilage and skin. Just below the protuberance and in the midline was a solitary eye. The lids were nicked in the midline to form a diamond-shaped opening. The orbital opening was oval and

Cyclopia, showing a single, centrally placed eye, a diamond-shaped orbit, total absence of the nose and the presence of a proboscis.

contained an oval eye, the cornea of which was smooth and continuously spherical. There was a smooth, flat surface between the eye above and the mouth below. The malar bones were fully formed and joined together in the midline, with no opening for the nose. There were no traces of nasal bones. The hard palate was fully formed, as was the mouth and tongue.

On section exposure of the brain showed incomplete development of the cerebrum, with the occipital lobes on a level with the posterior margin of the parietal bones, where the tentoria were attached. There was a space between the tentoria and the cerebellum which contained about 5 cc. of clear, yellow fluid. When the brain was lifted, the olfactory and optic nerves were seen to be missing. There was no chiasm. There was no sella turcica or clinoid processes and no pituitary body. There was fusion of the sphenoid bones to form an eminence where the sella should be. Probing from the orbit revealed an opening on each side of this

eminence covered with dura. The blind sac of the protuberance on the forehead was found to lead down to the orbit to a point above and behind the eye.

The foramen ovale and the ductus arteriosus were patent. The testicles were undescended, being low in the pelvis. The rest of the organs were normal.

Microscopic study of the proboscis showed cartilage overlaid with loose connective tissue within which were buried numerous compound tubular glands, lined with cuboidal epithelium. No mucosa was present. There was widespread congestion of all the blood vessels. The spleen showed congestion and many eosinophils. The liver showed sinuses packed with proliferating endothelial cells, lymphocytes and granulocytes. The diagnosis was cyclopia.

SUMMARY

A case of cyclopia is reported. The general description is one apparently of developmental defect due possibly to some toxin in the maternal system, which early produced some environmental change, thereby causing this type of monstrosity.

901 Washington Avenue.

CATARACT DUE TO DI-NITROPHENOL

WILLIAM A. MANN JR., M.D., CHICAGO

Attention has been called by several authors to the dangers in the use of di-nitrophenol as a form of treatment for obesity. Horner, Jones and Boardman [1] recently reported a series of cases in which rapidly developing cataracts were seen shortly following the use of therapeutic doses of the drug. The following case presents several rather important features which seem to establish a definite relationship between di-nitrophenol and the development of opacities of the lens.

REPORT OF CASE

Mrs. E. K., aged 27, was seen at the Northwestern University Medical School on July 23, 1935, complaining of poor vision in both eyes with gradual progression following the onset three weeks previously. The right eye had been the first to show change, followed almost immediately by reduction of vision in the left eye. The vision in the right eye was reduced to counting fingers at 2 feet and that in the left eye, to 16/200. The only ocular pathologic process found was in the lens, there being present bilateral immature cataracts. There was no red reflex in either eye, and slit-lamp examination revealed irregular gray opacities in each lens, with a few relatively clear areas at intervals, like a splitting between fibers. The whole lens area as seen through the dilated pupil showed involvement, but the opacities did not quite reach the anterior capsule.

From the Department of Ophthalmology, Northwestern University Medical School.

1. Horner, W. D.; Jones, R. B., and Boardman, W. W.: Cataracts Following the Use of Dinitrophenol: Preliminary Report of Three Cases, J. A. M. A. **105**:108 (July 13) 1935.

The patient first began to take di-nitrophenol on Jan. 28, 1934, on the advice of a druggist and confirmation by the Chicago Health Department. Two 4 grain capsules (0.26 Gm.) were taken daily until June 19, 1934, with a resulting loss of weight from 230 pounds (105.2 Kg.) to 185 pounds (83.9 Kg.). After several months the treatment was resumed, with only one of the 4 grain capsules daily. After about seven weeks the patient noted a slight yellowish tinge to the sclera in the right eye and discontinued the treatment, about a month before the vision began to fail.

A complete physical examination failed to reveal any pathologic process outside of the eyes. The basal metabolic rate was plus 13.4 per cent. Chemical examination of the blood demonstrated normal findings. The galactose test on the urine and the tests of liver function gave negative results. No di-nitrophenol could be detected in the urine. The hemoglobin was 92 per cent; the red blood corpuscles numbered 5,230,000, and the leukocyte count was 11,100.

COMMENT

The rapid development of bilateral cataracts in a woman 27 years of age shortly after she took rather large doses of di-nitrophenol is sufficiently significant to establish the drug as a very dangerous remedy, the use of which as a therapeutic agent does not seem at present to be advisable.

Ophthalmologic Review

OCULAR COMPLICATIONS OF CEREBROSPINAL MENINGITIS

EDWIN BLAKESLEE DUNPHY, M.D.
BOSTON

Cerebrospinal meningitis was first described as a clinical entity by Vieusseaux and Matthey in 1805. In this country cases were first reported in 1808, and there was a widespread epidemic in New England in 1814. The disease has been epidemic in various places from time to time. These epidemics are followed by quiescent periods in which isolated cases appear, and after a time fresh outbreaks occur. The condition is most commonly seen in children, but when it attains epidemic proportions persons of all ages are affected. Even in epidemics, cases occur usually in the winter and early spring months. Infection occurs by direct contact with a patient suffering from the disease or with a carrier.

Micrococcus intracellularis meningitidis was first accurately described by Weichselbaum [2] in 1887. It is a gram-negative diplococcus, growing only on mediums enriched with blood, ascitic fluid or starch. The colonies are round with smooth edges. They are translucent by transmitted light and bluish gray by reflected light. The optimum temperature for growth is 37.5 C. The organism is very sensitive to drying. Reduced oxygen tension greatly facilitates cultivation.

Like the gonococcus, the meningococcus ferments dextrose and maltose. These two organisms are frequently agglutinated by the same serums, but it has been demonstrated by Ellis that even in dilutions of 1:2 meningococcus serums agglutinate the meningococcus immediately or within one-half hour, whereas they agglutinate the gonococcus after one hour. Many strains have been isolated.

Since Flexner's [3] discovery of a specific serum the mortality from this disease has been greatly reduced.

SYMPTOMS

The disease has a sudden onset with chills, prostration and headache. At least 50 per cent of the patients show petechiae or a purpuric erup-

1. Vieusseaux and Matthey: J. de méd., de chir. et de pharmacie, Paris **11**: 243 (Jan.) 1806.

2. Weichselbaum, A.: Fortschr. d. Med. **5**:573 and 620, 1887.

3. Flexner, S.: Experimental Cerebrospinal Meningitis and Its Serum Treatment, J. A. M. A. **47**:560 (Aug. 25) 1906.

tion. Cervical rigidity and Kernig's signs are suggestive, but the final diagnosis rests with the demonstration of the organisms in the cerebrospinal fluid. The first stage of meningitis is preceded by bacteremia. The organism gains access to the blood stream from the rhinopharynx and can be isolated from the blood in some cases. It disappears rapidly from the blood shortly after localization in the meninges.

Herrick [4] studied 270 cases of meningitis at Camp Jackson in 1918. He came to the conclusion that the disease was not a primary meningitis but a meningococcic sepsis with secondary meningeal localization. In 45 per cent of his cases the condition was recognized before meningitis developed. The duration of the general systemic infection without meningitis lasted from a few hours to many days, the average being about forty-eight hours. One patient had meningococci in the blood stream for two weeks before meningeal signs made their appearance. The blood culture was positive in about one third of all the cases. By giving large doses of serum intravenously just before intraspinal therapy he was able to reduce the mortality to 14.8 per cent.

The disease does not confine itself entirely to the meninges but can invade the brain tissue itself. Wertham [5] discussed the histologic details in a study of 24 cases of purulent meningitis, many of which were due to the meningococcus. He stated that, apart from the encephalitic and toxic degenerative changes described in the literature, other extensive lesions of the nervous parenchyma occur. These lesions are on a circulatory basis, with toxic factors probably playing a subordinate part. The cortex is chiefly involved, but the subcortical structures, such as the basal ganglions, may be severely affected, especially in children.

The ocular complications of this disease do not occur as frequently now as reported in epidemics of years ago, owing, undoubtedly, to the prompt use of serum. Nevertheless, when they do appear they are of sufficient importance to command respect. Uhthoff,[6] in 1905, found ocular complications in about 50 per cent of his 110 cases. These consisted of optic neuritis in 18 cases, extra-ocular muscular palsies (usually due to paralysis of the abducens nerve) in 16 cases, pupillary anomalies in 12 cases and purulent inflammations of the uveal tract in 4 cases.

Gordon,[7] in an extensive survey of 1,090 cases of meningococcic meningitis in the Detroit epidemic in 1927-1931, found a much lower incidence of ocular complications, only 3.5 per cent. He reported the

4. Herrick, W. W.: Early Diagnosis and Intravenous Serum Treatment of Epidemic Cerebrospinal Meningitis, J. A. M. A. **71**:612 (Aug. 24) 1918.

5. Wertham, F.: Cerebral Lesions in Purulent Meningitis, Arch. Neurol. & Psychiat. **26**:549 (Sept.) 1931.

6. Uhthoff, W.: Ber. ü. d. Versamml. d. ophth. Gesellsch. **32**:84, 1906.

7. Gordon: Medical Report of Herman Kiefer Hospital, Detroit, 1927-1931.

following: conjunctivitis in 6 cases, iritis in 4 cases, iridocyclitis in 2 cases, chorio-uveitis in 1 case, choroiditis in 1 case, panophthalmitis in 9 cases, ophthalmoplegia in 4 cases, strabismus in 11 cases and optic atrophy in 1 case.

A study of the reports of various epidemics reveals the fact that the meningococcus of one epidemic may show a predilection for one tissue of the eye, whereas in another epidemic an entirely different ocular manifestation may predominate. Thus Knapp,[8] Kreitmair [9] and Jacobi [10] observed most frequently suppurative inflammation of the uveal tract. Wilson,[11] von Niemeyer [12] and Hess mentioned keratitis, while Hirsch,[13] in the Berlin epidemic, saw only conjunctivitis.

Apparently abortive cases may occur in which the meninges are not involved, the patient simply having a systemic infection with localization in the joints or perhaps only in the eye. Coats and Forbes [14] in 1911 cited four such cases, and in 1917 Temple Smith [15] reported an additional case of a child who during the course of a general upset showed an inflamed eye with hypopyon which progressed to pseudoglioma. The results of lumbar punctures were entirely negative, but meningococci had been found in blood cultures. Examination of the enucleated eye failed to reveal meningococci.

UVEAL TRACT AND RETINA

The most important ocular complication is iridocyclitis, and sometimes endophthalmitis occurs from massive invasion of the choroid or retina. This often goes on to vitreous abscess, with shrinking of the eyeball and the formation of pseudoglioma. According to Collins and Mayou,[16] the organism is conveyed to the eye by way of the blood stream and not by direct spread from the meninges. This opinion is now generally accepted. In almost all cases the ocular inflammation begins during the stage of bacteremia or shortly after the meningeal symptoms have made themselves evident. Occasional late involvement of the eyeball occurs, and this is probably due to septic emboli.

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8. Knapp: Centralbl. f. d. med. Wissensch. **33**:513, 1865.
9. Kreitmair: Aerztl. Int.-Bl. **22**:309, 1865.
10. Jacobi: Arch. f. Ophth. **11**:165, 1865.
11. Wilson: Dublin J. M. Sc. **43**:300, 1865.
12. von Niemeyer, F.: Die epidemische Cerebro-Spinal-Meningitis nach Beobachtungen im Grossherzogtum, Berlin, A. Hirschwald, 1865.
13. Hirsch, A.: Die Meningitis cerebro-spinalis epidemica, Berlin, A. Hirschwald, 1866, p. 64.
14. Coats, G., and Forbes, J. G.: Ophthalmoscope **9**:310, 1911
15. Smith, E. T.: M. J. Australia **1**:101 (Feb. 3) 1917.
16. Collins, E. T., and Mayou, M. S.: Pathology and Bacteriology of the Eye, Philadelphia, P. Blakiston's Son & Co., 1911, p. 511.

Collins and Mayou were able to examine pathologically an eye shortly after iritis with hypopyon had begun. They found an embolus lodged in the ciliary body, setting up iridocyclitis.

Haden [17] reported on the pathologic examination of an eye enucleated after endophthalmitis of meningococcic origin. The ciliary body and choroid were little changed except for infiltration by round cells, but just back of the lens was an area of inflammatory exudate attached to the retina. The retina was completely detached and disorganized. Near the optic disk there was a fusiform mass composed of fine fibers which were continuous with the fibers of the optic nerve. This did not seem like papillitis, but more like a drawing forward of the fibers by the inflammatory changes in the retina. The retrobulbar portion of the nerve showed considerable degeneration, but the nerve sheaths and intervaginal spaces were apparently normal. Haden believed that the vitreous abscess resulted from a septic embolus which had lodged in the retina.

Metz-Klok [18] made a postmortem examination of an eye which had undergone meningococcic endophthalmitis. He found only slight changes in the choroid and ciliary body, but there was extensive retinal inflammation with thrombosis of the central retinal vein and exudative hyalitis.

The organism has been demonstrated within the eyeball on several occasions. Axenfeld [19] cultivated it from an eye at postmortem examination. McKee [20] demonstrated it in the anterior chamber post mortem. Uhthoff [6] attempted to demonstrate it in 3 cases by aspirating the vitreous, but with negative results. Weakley [21] aspirated the pus from the anterior chamber during the development of uveitis and from it was able to grow a pure culture of the meningococcus.

CONJUNCTIVA

Conjunctivitis has long been recognized as a complication of epidemic meningitis. Cultivation of the meningococcus from the conjunctival secretion has been successfully accomplished by Robinson [22] and by McKee.[20] McKee made careful bacteriologic studies in 6 cases of conjunctivitis complicating epidemic meningitis. In only 2 cases were the results positive; the tests in the other cases showed mixed infections. The presence of gram-negative diplococci in the conjunctiva in cases of meningitis does not necessarily prove them to be meningococci. Axen-

17. Haden, H. C.: Am. J. Ophth. **1**:647 (Sept.) 1918.
18. Metz-Klok: Klin. Monatsbl. f. Augenh. **73**:379, 1924.
19. Axenfeld, T.: Die Bakteriologie in der Augenheilkunde, Jena, Gustav Fischer, 1907, p. 375.
20. McKee: Ophth. Rec. **17**:438 (Sept.) 1908.
21. Weakley, A. L.: Brit. M. J. **1**:47 (Jan. 8) 1916.
22. Robinson: Am. J. M. Sc. **131**:603, 1906.

feld [19] in 1907 reported the isolation of Micrococcus catarrhalis from the conjunctiva of a patient ill with epidemic meningitis. This year I have seen a similar case at the Children's Hospital in Boston. These cases would naturally be put down as cases of meningococcic conjunctivitis if the diagnosis had been made on the basis of the morphologic characteristics alone. Differentiation of the meningococcus from M. catarrhalis and the gonococcus must be carried out by careful comparison of their cultural characteristics.

Occasionally the meningococcus has been noted in eyes of patients not ill with epidemic meningitis. Brons [23] isolated the organism from the conjunctiva of a patient ill with keratomalacia. McKee observed it in a perfectly healthy boy while examining a series of normal conjunctivae. He suggested that the eye might be a portal of entry.

CORNEA

The cornea is not frequently involved. Wilson [11] reported 5 cases in which parenchymatous keratitis developed. Weil and Jost [24] reported an additional case. Niemeyer [12] and Ziemssen and Hess [25] mentioned this condition and also corneal ulceration. Zarzycki [26] has reported keratitis and corneal ulcers. He expressed the belief that these corneal disorders, along with conjunctivitis and the rare instances of meningeal dacryocystitis, are not caused by infection of the blood stream, but occur as a direct extension from the rhinopharynx. Foster Moore,[27] however, expressed the belief that the corneal ulceration is usually the result of exposure of the lower part of the cornea from incomplete closure of the eyelids during coma.

PUPILLARY REACTIONS

Pupillary abnormalities have been frequently reported. Randolph,[28] Lewis,[29] Bernoulli [30] and Lechler,[31] along with many others, mentioned cases with dilated and fixed pupils in which the eyes became normal with subsidence of the infection. Ballantyne,[32] in a review of 73 cases, found dilated pupils in 34 cases and contracted pupils in 5. There was some inequality noted in 18. Hippus was present in 31 and absence of light reflexes in 7.

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23. Brons, C.: Klin Monatsbl. f. Augenh. **45**:1 (Jan.) 1907.
24. Weil and Jost: Bull. Soc. d'opht. de Paris (July) 1926, p. 364.
25. Ziemssen and Hess: Deutsches Arch. f. klin. Med. **1**:442, 1865.
26. Zarzycki, P.: Bull. Acad. de med., Paris **78**:748 (Dec. 18) 1917.
27. Moore, R. F.: Medical Ophthalmology, London, J. & A. Churchill, 1925.
28. Randolph: Bull. Johns Hopkins Hosp. **4**:59 (June-July) 1893.
29. Lewis, P. M.: South. M. J. **26**:729 (Aug.) 1933.
30. Bernoulli: Klin. Monatsbl. f. Augenh. **71**:11, 1923.
31. Lechler: Med. Kor.-Bl. f. Württemberg **93**:9, 1923.
32. Ballantyne: Brit. M. J. **2**:190, 1907.

EXTRA-OCULAR MUSCLES

Strabismus is temporary and may vary from day to day during the disease. Ballantyne [32] noted it in 15 of his 73 cases. In 5 of these it was convergent, and in 10 it was divergent. In 1 of the cases of the convergent type the condition was truly paralytic and permanent. Uhthoff,[6] on the other hand, found that the convergent type predominated.

Nystagmus is rare. It was considered by Ballantyne to indicate a poor prognosis. He noted it 7 times in his series, and most of the patients exhibiting it died. In 3 cases it was vertical and in 1, rotary, and in 3 others it occurred in various combinations.

OPTIC NERVE

Optic neuritis is not infrequent, but papilledema is rare, Randolph [28] observed optic neuritis in 17 per cent of his 35 cases, and Uhthoff,[6] in 16 per cent of his 110 cases. Terrien and Bourdier [33] examined 3 patients post mortem in whose cases the only ophthalmoscopic sign was hyperemia of the papilla. They concluded that, first, the infection spreads along the sheath of the optic nerve as on the surface of the brain or in the spinal cord; second, it begins as an inflammation of the arachnoid and pia mater and may resolve or provoke lesions in the nerve itself, and third, it is most intense at the optic canal; sometimes secondary interstitial neuritis occurs, leading to atrophy of the optic nerve, but primarily the condition is perineuritis.

Lewis,[34] in a fairly recent article on the ocular neuropathies and amauroses in meningococcic meningitis, reported true optic neuritis in 3.8 per cent of his series and hyperemia of the disk and retina in 11.2 per cent. There was only 1 case of papilledema; this condition was shown at autopsy to have been caused by hydrocephalic block. All the patients with neuritis recovered good useful vision. There were 3 patients with complete blindness without ophthalmoscopic lesions. One of these patients came to autopsy, but the cause of the blindness was undetermined. Lewis expressed the belief that the cause must be some lesion anterior to the primary optic centers, probably intense neuritis at the chiasm. If the blindness were cortical, one would expect pupillary reactions to be retained.

Batten [35] often noted complete blindness as an early manifestation in infants. He believed that it was due not to optic neuritis but more prob-

33. Terrien and Bourdier: Arch. d'opht. **29**:301, 1909; **30**:214, 1910.

34. Lewis, P. M.: South. M. J. **24**:101 (Feb.) 1931.

35. Batten, quoted in Garrod, A. E., and Thursfield, H.: Diseases of Children, New York, Longmans, Green & Co., 1913, p. 749.

ably to overwhelming toxic impairment of the higher visual centers. In his experience the pupils remained active but sluggish, and sight was restored in almost all cases though sometimes not until many weeks had elapsed.

Gay [36] and Nettleship [37] each published a report of a series of cases of acute cerebral amaurosis of infancy. In most of the cases the condition was associated with meningitic symptoms. Blindness was complete, but pupillary reflexes were retained. Most of the patients recovered after a period of weeks, but occasionally optic atrophy developed.

TREATMENT OF OCULAR COMPLICATIONS

In general, instillation of atropine, soaks in hot boric acid and protection from excessive light constitute the treatment of the purely inflammatory complications. Zarzycki [26] recommended the following therapeutic measures: (1) for those complications originating in the nasopharynx (conjunctivitis, keratitis and other conditions) the instillation of drops of antimeningococcus serum into the conjunctival sac and a spray of serum in the nose; (2) for dacryocystitis, the injection of polyvalent serum into the lacrimal sac; (3) for iritis and metastatic ophthalmia, subconjunctival injections of serum; (4) for ocular complications of central origin, intravenous and intraspinal injections of serum.

Injections of meningococcus serum have been made directly into the vitreous by Netter [38] in 2 cases in which there was purulent iritis with hypopyon. In 1, the meningococcus was recovered from the anterior chamber by aspiration. Netter stated that immediate improvement was noted in both cases, the hypopyon disappearing and the whole process quieting down. Both cases were in small children, and no final visual acuity was recorded.

Curran [39] reported a case in which nine years previously he had injected antidiplococcus serum into the anterior chamber to combat beginning purulent iritis. The eye improved rapidly, but at the time of the report there was only light projection, because of old organized exudate over the surface of the lens.

The intra-ocular injection of meningococcus serum is well worth consideration as a therapeutic measure in cases of early ocular involvement. Although no startling recovery of visual acuity has been reported in the few cases in which it has been tried, further study of this procedure and perfection of technic may lead to a means of combating a hitherto hopeless condition.

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36. Gay: Roy. London Ophth. Hosp. Rep. **13**:404, 1893.
37. Nettleship, E.: Tr. Ophth. Soc. U. Kingdom **4**:245, 1884.
38. Netter: Compt. rend. Soc. de biol. **78**:90, 1915.
39. Curran, E. J.: J. Kansas M. Soc. **26**:356 (Nov.) 1926.

News and Notes

SOCIETY NEWS

International Ophthalmological Congress.—The International Ophthalmological Congress will hold its fifteenth session in Cairo, Egypt, in September 1937. The principal subject for discussion will be "The Eye and Disturbances of Internal Secretion," to be divided as follows:

"General Introduction," Prof. J. Snapper, Amsterdam.

"The Eye and Hypophysis," Prof. P. Jeandelize, Nancy.

"The Eye and Thyroid Gland," Prof. A. von Szily, Münster.

"The Eye and Parathyroid Gland," Prof. G. Lo Cascio, Padua.

"The Eye and Pancreas," Prof. E. S. Lacarrére, Madrid.

"The Eye and Adrenals," "The Eye and Sexual Hormones," and "The Eye and Pregnancy," Prof. J. Imre, Budapest.

Ophthalmological Society of the United Kingdom.—The Annual Congress of the Ophthalmological Society of the United Kingdom will be held in London on April 2 to 4, 1936. The subject for discussion will be ophthalmia neonatorum. There will also be five minute demonstrations of exhibits of scientific material and apparatus. Members who wish to read papers are requested to send titles to the secretary, J. D. M. Cardell, Esq., 27 Weymouth Street, London, W. 1., and abstracts should be in Mr. Cardell's hands not later than March 1, so that they may be prepared for distribution at the meeting. Those who desire to take part in discussions or in the demonstration of exhibit material are requested to communicate with Mr. Cardell before February 15.

Philadelphia County Medical Society.—At the scientific meeting of the Eye Section of the Philadelphia County Medical Society, held on Jan. 2, 1936, the following program was presented: "Case of Blindness Following Toxemia and Nephritis of Pregnancy," Dr. Samuel Phillips; "Traumatic Iridodialysis; Presentation of Two Cases, One with Non-surgical Reattachment," Dr. Mortimer W. Blair; "Disappearance of Cataractous Lens Following an Attack of Iritis," Dr. Frank A. Murphy; "Retinitis Pigmentosa with Special Reference to Sympathectomy as a Means of Treatment and Report of Three Cases" (presentation of patients), Dr. Charles W. Le Fever.

CORRECTION

In the report of the meeting of the German Ophthalmological Society held Aug. 6 to 8, 1934, which appeared in the May issue (ARCH. OPHTH. **13**:914, 1935), the name of the reporter, Dr. Frederick Poos, was omitted in the last paragraph on page 926; in other words, the remarks appearing under "Comment" on that page were made by Dr. Poos.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Biochemistry

CHLORINE CONTENT OF AQUEOUS, VITREOUS AND SERUM. P. W. SALIT, Am. J. Ophth. **17:** 818 (Sept.) 1934.

Salit reports the results of his study of the chlorine contents of the aqueous, vitreous and serum in calves from 4 to 6 weeks old. These results corroborate those of previous investigators. The chlorine contents of aqueous and vitreous are practically the same and appreciably higher than that of serum.

W. S. REESE.

PHYSICAL CHEMICAL CONSTANTS OF THE BLOOD IN RELATION TO SENILE CATARACT. E. TROVATI, Ann. di ottal. e clin. ocul. **63:** 598 (Aug.) 1935.

Complete examinations of the blood including the blood chemistry were made in twenty-five cases of senile cataract. The blood picture, the coagulation time, the sedimentation time, the resistance of the red cells and the viscosity of the blood were without constant changes. The blood pressure varied, corresponding to that of persons of the same age group. The uric acid of the blood was normal. In contrast to the findings of some other observers, the sugar showed a slight decrease from normal, the average finding being 74.6 mg. per hundred cubic centimeters of blood. A fairly definite elevation in cholesterol was observed in the group—400 mg. per hundred cubic centimeters. There was a fairly constant but slight decrease in calcium, 9.77 mg. per hundred cubic centimeters, and an increase in potassium, 29.66 mg. per hundred cubic centimeters, giving a potassium-calcium quotient above normal (3.03). The alkaline reserve by the Van Slyke method showed a slight relative acidosis. A bibliography is given.

S. R. GIFFORD.

THE ASCORBIC ACID CONTENT OF THE RETINA AND ADRENALS OF ANIMALS. H. BRACCI-TORSI, Arch. di ottal. **42:** 80 (March-April) 1935.

The method of Harris and Ray was employed, with a number of additional precautions to insure accuracy. By bubbling carbon dioxide through the solutions before testing them, the very rapid reduction of ascorbic acid which occurs without this procedure is reduced to the minimum, and this is advised whenever a solution cannot be tested immediately. The retina and adrenals of beef and swine were employed, the amount of ascorbic acid per gram of fresh tissue being estimated.

For young cattle from 1½ to 3½ years of age the amount in the retina varied from 0.11 to 0.17 mg. per gram, the average being 0.14 mg. The

amount in the adrenals averaged 1.1 mg. per gram. In cattle from 6 to 12 years of age the amounts were slightly less, averaging 0.13 mg. per gram for the retina and 1.103 mg. per gram for the adrenals.

In swine from 5 to 10 months old the amount in the retina averaged 0.085 mg. per gram and for the adrenals 0.93 mg. per gram. No constant relation was observed between the amounts present in the retina and adrenals.

S. R. GIFFORD.

THE RÔLE OF VITAMIN C IN THE OXIDATION PROCESS OF THE LENS. P. WEINSTEIN, Arch. f. Augenh. **109:** 221, 1935.

The lens separated from the blood stream can take up the oxygen necessary for its metabolism only by an oxidation-reduction system. This system, first discovered by Hopkins, is found in glutathione. Glutathione gradually disappears from the lens during the development of cataract, but the cysteine reaction can still be found in the capsule of the lens after it is no longer demonstrable in the ripe cataract. The lens and aqueous also contain significant amounts of a reducing substance identical with vitamin C. This substance also vanishes gradually from the lens and from the aqueous during the development of cataract until finally it is to be found only in the capsule. In the oxidation processes of the lens a substance is necessary which withdraws hydrogen from tissues, such as the so-called hydrogen transporters, for example, cysteine. Cysteine contains a labile hydrogen atom which it gives off easily and changes thereby to cystine. Vitamin C is a strong reducing agent giving off hydrogen easily and thereby being transformed into its oxidized form.

Weinstein shows that in vitro the reduced form of vitamin C protects cysteine from becoming oxidized. He explains the formation of cataract with developing age by asserting that the permeability of the blood vessels is changed in senility so that the transport of certain crystalloids (sugar, vitamin C) into the aqueous is prevented, and in association with this the internal respiration of the lens diminishes, which leads to progressive cloudiness of the lens.

F. H. ADLER.

INFLUENCE OF CAROTENE ON THE CHEMICAL PROCESSES IN THE EYE. B. G. TOVBIN, H. GORODISSKY and G. W. DROBOVA, Arch. f. Ophth. **133:** 578 (April) 1935.

It is now generally believed that vitamin A can originate from carotene and that the liver of many animals contains a ferment which is capable of transforming carotene into vitamin A. Russian authors (von Ratschevski, Orlov, Tovbin) have used carotene for the treatment of inflammatory diseases of the eye and have seen favorable results.

In this paper experiments on rabbits are reported which suggest that certain chemical processes in the eye are modified by repeated instillations of carotene. The general plan was as follows: One eye was subjected to a trauma (peripheral or total iridectomy, nonperforating cauterization of the center of the cornea, etc.). One half of the animals received instillations of carotene, once a day for four days following the operation. Then the animals were killed, and the intra-

ocular fluids were withdrawn and tested for their dextrose and total nitrogen content and for their glycolytic capacity. The dextrose content of the aqueous was found to be increased in the injured eyes. This increase was perhaps less pronounced in the eyes that had been treated with carotene. In some of the control eyes the mates of which had received carotene the dextrose content of the aqueous was lower than in other control eyes the mates of which had not been given carotene. The authors interpret this as a sign indicating that the state of irritation of one eye had been transmitted to its mate. The total protein content of the aqueous was increased in the injured eyes. Carotene seemed to enhance this process. The figures for the glycolytic capacity varied a great deal. The number of observations was, on the whole, very small. The reader of the paper is not quite certain that the authors were aware of the great spontaneous variations of the dextrose content of the aqueous in rabbits. Furthermore, it makes the reader somewhat uncomfortable not to find any data concerning the limit of error in the chemical determinations.

P. C. KRONFELD.

Color Sense

PSEUDO-ISOCHROMATIC TEST CARDS OF STILLING, NAGEL AND ISCHIHARA. P. KISSIN and B. EIDELMANN, Arch. f. Ophth. **133**: 298 (Jan.) 1935.

With these test cards 128 color-blind persons and 300 normal controls were tested in good daylight and in artificial light. The eighteenth edition of Stilling's, the eleventh of Nagel's and the fifth of Ischihara's test cards were used. Stilling's test cards were found to be the most sensitive ones. With some of the patterns (especially card 12 and group 15) it was difficult to obtain a definite result because even the controls read them with great hesitation and made mistakes frequently. Very good daylight was necessary. Artificial light, however, could be used also if certain precautions were observed.

Ischihara's plates were also very sensitive. Their main advantage was the certainty with which the persons with anomalous color sense made their statements. The plates designed for the differentiation between protanopes and deuteranopes were found to be very useful. Even in poor daylight definite results were obtained. Under electric light the pigment colors changed so much that the cards were practically useless.

Nagel's plates showed the least degree of sensitivity. Much experience and patience on the part of the examiner were necessary to diagnose the condition in certain cases. The authors stress the point that the three sets of pseudo-isochromatic patterns differ from one another in several respects and can therefore serve as supplements to one another.

P. C. KRONFELD.

DETECTION OF COLOR BLINDNESS WITH THE LEUKOSCOPE OF HERING. A. TSCHERMAK-SEYSENEGG, Arch. f. Ophth. **133**: 410 (Feb.) 1935.

The criterion of color blindness in most of the methods used for its detection is either failure to recognize pseudo-isochromatic patterns or

the acceptance of equations between pseudo-isochromatic mixtures of colors. The latter method has the disadvantage that a trained observer often, within the limits set by the particular type of apparatus, cannot find an equation which really satisfies him. Tschermak-Seysenegg has introduced a new principle, namely, the apparent colorlessness of color mixtures. Hering has designed the so-called leukoscope for the demonstration of the fact that a mixture of three suitable colors produces a colorless impression in the normal observers. In dichromates (protanopes, deuteranopes, blue-yellow-blind persons) two colors are sufficient to produce the impression of colorlessness. In the leukoscope glass filters provide the colored lights which are mixed by prisms. The quantitative relations can easily be modified to suit every observer.

For the correction of red-green blindness Tschermak-Seysenegg like many others recommends the use of a red glass over one eye and a green glass over the other. When the color-blind person is asked to recognize the color of an object he puts his "glasses" on and looks at the object with one eye after the other. An object that looks darker to the eye carrying the red glass is green, and vice versa.

P. C. KRONFELD.

Conjunctiva

SUBCONJUNCTIVAL IRON DEPOSITS AFTER ADRENIN INJECTIONS. T. GUNDERSON, Am. J. Ophth. **17:** 807 (Sept.) 1934.

Gunderson found that the black deposits found after subconjunctival injections of adrenin were due to the solution of iron from the needle by the acid solution of adrenin and subsequent precipitation. To obviate this he suggests the use of platinum or gold needles and adrenin-saturated pledgets instead of injections and the allowance of very little time for contact between the adrenin and the needle.

W. S. REESE.

A CASE OF PSEUDOMEMBRANOUS NONDIPHTHERITIC CONJUNCTIVITIS ACCOMPANYING ERUPTIVE AND BUCCOPHARYNGEAL LESIONS. M. BENOIT, Ann. d'ocul. **172:** 222 (March) 1935.

A case of pseudomembranous conjunctivitis in the course of an eruptive infectious condition is reported because of the absence of any specific micro-organism.

J. T., a man aged 31 years, came for consultation because of an ocular condition which had started four days previously. This had been preceded by a general physical disturbance which had necessitated a visit to his physician. More than a month previously he had been seized with a sensation of extreme cold in the lower limbs; his lips became a violet color; his temperature was normal. This condition continued for about an hour and a half and then disappeared, but reappeared, off and on, until his visit to Benoit the following month.

The condition was thought to be due to either diphtheria or to a streptococcic infection, and the patient was referred to Dr. Morax for a bacteriologic examination. Microscopic examination failed to show either the diphtheria bacillus or other micro-organisms. An examina-

tion for spirochetes also gave negative results, and the cultures remained sterile. The case is reported because the etiology of the disorder remains obscure.

S. H. McKee.

Some Aspects of the Conjunctival Circulation in General Arterial Hypertension. A. Rollin, Bull. Soc. d'opht. de Paris, December 1934, p. 628.

The capillary circulation of the conjunctiva as studied with the microscope has been reported on by Dennis, Vogt, Zeller, Koeppe and Fischer. The findings are somewhat contradictory. Certain authorities reject the statement that lesions exist in the capillaries, while others, in particular O. Müller and H. P. Wagener, saw changes in the capillaries and tortuous vascular abnormalities. It seems apparent that a distinction must be made between the changes in the cutaneous capillaries and those in the visceral capillaries in hypertensive disorders.

Rollin considers the true capillaries of the conjunctiva to be those noted at the limbus, and it is toward these that his experiments are pointed. At certain times there are spasms which are intermittent and of short duration, having little if any effect on the general circulation. There is reason to believe, however, that if the capillaries are modified in general hypertension the modification is constant. The modification may be of two orders: one occurs in general hypertension without renal lesions or toxemia, and one in hypertension with demonstrable renal changes.

Rollin has made a special study of fourteen cases; the first seven are classified as cases of solitary hypertension, i. e., without lesions of the kidneys, and the last seven as cases of hypertension with renal insufficiency. In none of the first group, in which there was a general arterial tension of from 180 to 270, was there a single incidence of obliteration of the capillary network. The only sign found in this group was a frequent dilatation and increase in the number of conjunctival veins. The seven cases in the first group are described in short detail.

In the second group there was a consistent finding of sclerotic atrophy of the prelimbal capillary network. In addition, aneurysms of the arterioles and varices of the venules were a constant accompaniment. The blood urea was enhanced in all the cases of the second group. The seven cases are noted in brief detail. An excellent bibliography is appended.

L. L. Mayer.

Comparative Ophthalmology

The Visual Cells of Lampreys. G. L. Walls, Brit. J. Ophth. **19:** 129 (March) 1935.

Walls states that the question of the nature of the visual cells of the most primitive of living vertebrates, the lampreys, is especially in need of a final answer because of its bearing on the problem of the priority of origin of the rods and cones. He reviews the opinions held by previous investigators and shows that all possible views have been advanced. With hope of finding a meaningful differentiation of the two types of cells he analyzes the following features of the species of the genus Lampetra and other genera as yet not studied or but superficially

studied by others: the form and size of the outer segment; the presence or absence of rhodopsin in certain cells; the relative extent of summation of the cell types in bipolar and ganglion cells; the relative numbers of the cell types in relation to pelagic vs. benthic, and diurnal vs. nocturnal habits; the relative numbers of the cell types in the fundus as compared with the periphery; the direction of migration in light and darkness; the differentiation of the nuclei, and the differentiation of the foot-pieces.

He concludes that one is not dealing with "undifferentiated" cells. Nor can the retina of the lamprey be considered either all rods or all cones. It is certain that both rods and cones are present, and it is equally certain that Heinrich Müller alone has hitherto held the correct view—that the long cells are cones and the short cells rods. Though the differentiation is "perfect" only in Entosphenus tridentatus and (histologically) "poor" in the genus Ichthyomyzon, there is surely no reason to suppose that these identifications do not hold for all Holarctic lampreys. The situation in Geotria and related genera is entirely unknown, though Plate (*Allgemeine Zoologie und Abstammungslehre, in Die Sinnesorgane der Tiere,* Jena, Gustav Fischer, 1924), has given observations on a macrophthalmia of G. chilensis which he himself says was *"schlect konserviertes."*

The presence of both rods and cones in these, the most primitive vertebrates, makes it impossible to rely, as Schultze did, on comparative adult histology to solve the problem of the order in which the rod and cone originally evolved. Walls hopes eventually to present an embryologic attack on this problem, for the comparative histogenesis of vertebrate retinas, structural and physiologic, appears now to be the sole possible source of evidence.

This contribution comes from the departments of zoology of the University of Michigan and the University of Iowa.

The article is illustrated and supplies an extended bibliography.

W. ZENTMAYER.

Congenital Anomalies

POSTERIOR LENTICONUS (REPORT OF A CASE). T. H. LUO, Brit. J. Ophth. **19:** 210 (April) 1935.

This anomaly was seen in a Chinese boy. His mother had similar lens opacities. Vision was 6/20 with the right eye and 6/30 with the left eye, unimproved by lenses. The biomicroscope showed, in the left eye, that the posterior surface of the lens protruded unduly into the vitreous. This protrusion was cup-shaped with a diameter of about three-fourths the diameter of the lens and a depth about equal to the thickness of the lens. Its edge was rounded off gradually like that of a basin. The walls of the conus were densely opaque. The opacity consisted grossly of two layers which were grayish white with an irregular punctate appearance. The formation of the conus seemed to start from the posterior peripheral band of the embryonic nucleus, and the opacity involved the band and what was behind it. In the right eye there was an irregularly shaped opacity at the posterior pole of the embryonal nucleus. The opacity was densest at its center, and there was an irregular shallow depression on its anterior surface. The lens substance anterior

and posterior to this region was clear. Neither the Vogt ring reflex nor the Marsh scissors reflex was present.

There is a discussion of other cases in the literature. The article is illustrated.

W. ZENTMAYER.

PATHOLOGIC RETARDATION OF THE ABSORPTION OF THE PUPILLARY MEMBRANE AND ITS RELATION TO OTHER DISEASES. W. SCHLODTMANN, Klin. Monatsbl. f. Augenh. **93**:623 (Nov.) 1934.

Prompted by K. Hansen and his research on hemolytic icterus, Schlodtmann examined the eyes of 800 persons as they came under his observation. He selected 100 patients of each decade of life from the first to the seventh and an equal number of patients over 70 years of age. Aside from other incidental anomalies, remnants of the pupillary membrane were found in 389 patients, i. e., in an average of 48 per cent, and in 16 of 21 patients with hemolytic icterus, i. e., in 76 per cent. Schlodtmann suspects that the frequency of this ocular anomaly in Switzerland, on which Stähli reported, may have some relation to the frequency of dysfunction of the thyroid gland in that country. Similar connections between persistent pupillary membrane and other diseases may be discovered later on. They may represent a certain syntropy, according to Pfaundler, a coordination of symptoms, based on a common origin.

K. L. STOLL.

Cornea and Sclera

CORNEAL GRAFTING—REPARATIVE AND OPTICAL. R. E. WRIGHT, Brit. J. Ophth. **19**: 341 (June) 1935.

In a case of corneal ulcer with descemetocele and fistula Wright employed a graft obtained from the cornea of a blind glaucomatous eye. As an optical achievement the operation was a failure, but as a reparative procedure it was a success.

In the second case, a bilateral leukoma, the sequel of a syphilitic interstitial keratitis, was similarly operated on The vision before the operation was hand movements close to the eye. The ultimate vision was, in the right eye, fingers at 2 feet (60.9 cm.), and in the left eye, 1/60.

An ordinary 2 mm. sclerocorneal trephine blade was used to demarcate from a blind glaucomatous eye a disk to a uniform depth of about one third of the thickness of the cornea, and was then sloped to about 45 degrees and rotated so as to cut through at one point. With a small Graefe knife the disk was cut out, its edge of such a bevel that the endothelial aspect of the disk was distinctly less than 2 mm. It was placed in a watch-glass containing olive oil. A 2 mm. trephine blade was used to demarcate a circular cut around the healing edge of the ulcer and a 1.5 mm. blade used to cut through at the base of the descemetocele. Between these two circular incisions a beveled edge was carefully cut with fine scissors. The graft was transferred, and retaining sutures which had been loosely placed in position beforehand were then tightened over the graft. The terminal exit of the suture was close to the

sclerocorneal juncture. The thread used was fine silk sterilized in wax; the needles, Barraquer's fully curved. Liquid paraffin with atropine was instilled.

W. ZENTMAYER.

HEMATIC DISCIFORM INFILTRATION OF THE CORNEA. F. SCHOUSBOË and G. MORARD, Bull. Soc. d'opht. de Paris, January 1935, p. 17.

Schousboë and Morard report two cases. In the first an infant of 5 years was struck in the left eye with a rifle butt. There was an immediate hemorrhage completely filling the anterior chamber. After some weeks the hemorrhage had partially absorbed, leaving a whitish disk which looked like a luxation of the lens into the anterior chamber, but as glaucoma ensued the child was hospitalized and enucleation followed. On histologic examination the disk was found to be red blood corpuscles in the stroma of the cornea.

The second patient was in an automobile accident. The entire anterior chamber of one eye was filled with blood. Gradually a whitish disk was seen to form in the globe. With the experience of the first case to be considered, a diagnosis of disklike hemorrhage into the cornea was made. There was a gradual clearing, and on last examination a small leukoma like a tiny lens was all that remained of the disk. A review of the literature reveals that every such condition reported on was due to an injury. Hypertonia is a usual complication. The authors suggest that instead of referring to the condition as apoplexy, hemorrhage, infiltration or impregnation or pigmentation of the cornea, the term "hematic disciform infiltration of the cornea" be used. Pictures and a bibliography are included.

L. L. MAYER.

General Diseases

FUNDAMENTAL TREATMENT OF OCULAR TUBERCULOSIS. G. LEOZ, Arch. de oftal. hispano-am. **35**: 230 (May) 1935.

In this paper the author stresses the importance of ocular tuberculosis, in the treatment of which he gives predominant importance to serum and gold preparations.

He describes in detail the present status of medical knowledge as regards immunity, antigens, antibodies, toxins, anaphylaxis, allergy, desensitization and tuberculins in relation to diagnosis and treatment.

In connection with tuberculin used in diagnosis he favors the Mantoux method, and in employing tuberculin for treatment he prefers Beraneck's tuberculin. He details the application of tuberculin in ocular tuberculosis with the necessary precautions and considers that, properly managed in expert hands, tuberculin is never harmful. He usually commences with a dose of tuberculin in a dilution of from 1 : 10,000,000 to 1 : 1,000,000. He gradually increases the dose according to the general and local reactions; no fixed and systematic rules can be established, each patient requiring individual attention. This treatment he reinforces by hygienic measures, increased nourishment, injections of lecithin, nonspecific protein therapy and local measures of different nature.

He reserves gold therapy for use in those cases in which tuberculin has failed and details the present status of knowledge in regard to it,

the indications and contraindications for its use and the different methods of administering it. As with tuberculin, no fixed rules can be established, variations depending on the reactions in each case. Of the different forms employed, he prefers the combination gold sodium.

C. E. FINLAY.

EPIBULBAR SUBCONJUNCTIVITIS IN EPIDEMIC PAROTITIS. H. RIEGER, Arch. f. Ophth. **133:** 505 (Feb.) 1935.

Two cases of this rare complication of mumps are reported. The ocular disease resembles closely the metastatic subconjunctivitis of gonorrheal origin.

P. C. KRONFELD.

General Pathology

PATHOLOGIC LIPOID INFILTRATION OF THE CORNEA AND SCLERA. P. A. JAENSCH, Arch. f. Ophth. **133:** 361 (Feb.) 1935.

Jaensch has for several years been engaged in studies of physiologic and pathologic lipoid infiltration of the eye. He now reports his findings in and around corneal wounds and scars. In some glaucomatous eyes he has found fat in the epithelium of the cornea; in cases of glioma, pseudoglioma and vitreous abscess fat had been deposited around the canal of Schlemm. His findings in three cases of scleritis are very interesting. In these the fat was located in the innermost layers of the scleritic nodes. One case of malignant scleritis (E. von Hippel) is described in detail.

P. C. KRONFELD.

Glaucoma

INFANTILE GLAUCOMA. J. F. HARDESTY, Am. J. Ophth. **17:** 689 (Aug.) 1934.

Hardesty reports the case of a 2 month old baby in which a diagnosis of interstitial keratitis was first made but later changed to one of glaucoma, the tension of both eyes being 50. The baby's eyes improved under miotics and roentgen treatment of the thymus. In a second case of infantile glaucoma with tension persistently from 45 to 55 and with marked vagotonic manifestations, suggesting hyperactivity of the thymus, there was general as well as ocular improvement under ephedrine, ⅛ grain (0.008 Gm.), three times daily. He concludes that it is wise in cases of infantile glaucoma to consider the possibility of thymic hyperactivity.

W. S. REESE.

MICROPHAKIA AND SPHEROPHAKIA WITH GLAUCOMA. T. M. SHAPIRA, Am. J. Ophth. **17:** 726 (Aug.) 1934.

Shapira reports the case of a 10 year old boy who apparently became short-sighted after the sixth year. In 1929 a diagnosis of myopia gravis was made, and the following year bilateral glaucoma was diagnosed. In 1930 it was noted that pilocarpine hydrochloride brought on a glaucomatous attack, and in 1932, that homatropine hydrobromide lowered

the intra-ocular tension. Examination of both eyes revealed iridodonesis and shallow anterior chambers. The zonule and entire border of the lens were visible through a pupillary area of 8 mm. Biomicroscopy showed marked curving of the anterior and posterior surfaces of the lens and an obtuse-angled equator. Without drops the tension was 36 mm. (Schiötz) but rose to 51 on administration of pilocarpine hydrochloride. After the use of homatropine hydrobromide the tension fell to 25, and following treatment with atropine, to 15. Both lenses were removed, and fairly good vision was obtained with the usual aphakic correction, the myopia quite evidently being lenticular. A second case occurring in an imbecile is reported, and the literature is reviewed.

W. S. Reese.

Chronic Glaucoma and Arterial Hypotension Therapy. Jean Gallois, Bull. Soc. d'opht. de Paris, March 1935, p. 165.

A patient of 61 years had the usual symptoms of simple glaucoma. The visual acuity and the visual fields were normal. On each side there was a manifest excavation extending to the margin of the disk. Tension was 45 mm. for the right and 30 mm. for the left eye. An arterial pulse was seen only in the right eye. The general examination gave negative results except for a blood pressure of 168 systolic and 84 diastolic, with some sugar in the urine. One was impressed by the patient's aspect of fatigue and depression. An alimentary regimen with exclusion of all except local medication was instituted. Locally solution of pilocarpine hydrochloride was dropped into the eye morning and night. The tension of the right eye fell rapidly to 20 mm. and remained there. The visual acuity increased from 2/3 to 10/10. In the left eye, however, the tension fell in a leisurely manner. It was four weeks before it became normal. Gallois believes that the absolute blood pressure reading is of little importance, but that the comparison of the intra-ocular tension and the general diastolic tension is of utmost importance. The rigor of the dietary regimen is well worth the results obtained.

L. L. Mayer.

Lacrimal Apparatus

Importance of X-Ray Examination in Diseases of the Lacrimal Apparatus. J. M. Ortiz Jr., Arch. de oftal. hispano-am. **35:** 57 (Feb.) 1935.

This paper illustrated by numerous radiograms emphasizes the importance of x-ray examination in diseases of the lacrimal sac and duct from both a diagnostic and a preoperative point of view, as well as with the object of appreciating operative results.

The author employs a preliminary injection of an iodized 20 per cent sicut Unterberger or 40 per cent sicut Bermacher oil. The roentgenograms are taken in a frontal position with the application of the nose and forehead to the plate and of the x-ray tube to the external occipital protuberance.

A brief review of the literature on the subject precedes the treatment of the subject matter.

C. E. Finlay.

Lens

ECTOPIA OF THE LENS. BENITO JUST TISCORNIA, Arch. de oftal. de Buenos Aires **10:** 251 (April-May) 1935.

After limiting, with Fuchs, the name "lenticular ectopia" to congenital subluxations, mostly bilateral, symmetrical and hereditary and after stressing their rarity, the author reports a case in which no hereditary data were obtainable.

C. E. FINLAY.

MY EXPERIENCE IN PHAKO-ERISIS. J. MARGENAT, Arch. de oftal. de Buenos Aires **10:** 285 (April-May) 1935.

This is a paper read by invitation before the Ophthalmological Society of Buenos Aires, in which the author explains at length all the details of this operation as performed at Barraquer's clinic and reports seven cases performed by invitation at the Ramos Mejia Hospital of Buenos Aires, with the most satisfactory results.

C. E. FINLAY.

TRAUMATIC ROSETTE CATARACTS. J. M. V. ORTIZ JR., Arch. de oftal. hispano-am. **35:** 113 (March) 1935.

This is a report of four cases of rosette cataract of traumatic origin localized, with slit lamp, three in the subcortical posterior layer and one in the anterior layer at the level of the adult nucleus. The author calls attention to the fact that the traumatic origin at first attributed to all cases has not been confirmed in all.

C. E. FINLAY.

RELATION BETWEEN THE PARATHYROID GLANDS AND CATARACT IN YOUNG PEOPLE. O. ROMANOWA, Arch. f. Ophth. **133:** 142 (Nov.) 1934.

Romanowa gives a fairly complete review of the literature concerning this subject. In certain types of tetany, pathologic changes of the parathyroids have been demonstrated with certainty. A large amount of clinical and experimental data indicates that hypofunction of the parathyroids usually leads to lowering of the blood calcium. The symptoms of tetany can be elicited not only by a low absolute blood calcium but also by a change in the potassium-calcium quotient or in the amount of ionized blood calcium. Lowering of the blood calcium, however, does not always lead to spasms. Because of these complicated relations a strict parallelism between the lowering of the blood calcium and the symptoms of tetany cannot be expected. Romanowa has determined the blood calcium and potassium in twenty-two cataractous patients under 43 years of age. Most of them showed zonular cataract. The patients were also tested for signs of latent tetany (Trousseau's, Erb's and Chvostek's signs). A calcium content under 9.5 mg. per hundred cubic centimeters of blood (determined by de Waard's method) or a potassium-calcium quotient over 2.5 was considered indicative of hypofunction of the parathyroids. One third of the patients belonged in this group. The neurologic signs of latent tetany were found in six

patients, only one of whom had low blood calcium. Romanowa apparently does not consider the possibility that at the time of the onset of the cataract the evidence in favor of hypoparathyroidism may have been much stronger.

P. C. KRONFELD.

Lids

ENTROPION ORIGINATING AT THE EXTERNAL ANGLE. A. POULARD and E. HARTMANN, Bull. Soc. d'opht. de Paris, January 1935, p. 16.

Among the different types of entropion, not cicatricial, of the lower lid is the spasmodic type, which is not infrequently seen. Usually this type begins at the outer canthus. The authors have obtained lasting results in fifteen cases. The first of the patients was operated on five years ago. The procedure has four steps: (1) classic external canthotomy, (2) section, below and above, of the fiber bands which pass to the expansion of the external palpebral ligament, (3) maintenance of the freed lids in position by a tarsorrhaphy particularly including the level of the external angle, and (4) suturing of the superior lid into the canthotomy incision.

L. L. MAYER.

Methods of Examination

KINETIC VELONOSCOPY. P. GOOD, Am. J. Ophth. **17:** 711 (Aug.) 1934.

Good defines velonoscopy and divides it into static and kinetic. He describes how it is used by different men and makes the following conclusions: "(1) Kinetic velonoscopy is a quicker and more accurate method than the previous methods of velonoscopy. (2) The test is an accurate and rapid check on skiascopy and is especially valuable when scissors motion and lens irregularities make skiascopy difficult. (3) Theoretically, velonoscopy is to be preferred to skiascopy because the refraction of the visual axis, and particularly of the macula is tested as they are actually used, and not the optical axis in relation to various peripheral parts of the retina. (4) Velonoscopy is a valuable method for the determination of the variability of astigmatism in the eye; for example, when the pupil is contracted or dilated, and when the eye is under tension of the external muscle, such as in convergence. (5) Velonoscopy is a valuable method for the determination of achromatic aberration of the human eye."

W. S. REESE.

INFRA-RED PHOTOGRAPHY OF THE EYE: II. THE IRIS PIGMENT. H. M. DEKKING, Arch. f. Ophth. **133:** 20 (Nov.) 1934.

In photographs of the human eye taken in infra-red light a brown looks lighter than a blue iris. This indicates that the pigment of the iris reflects most of the infra-red rays (8,100 angstroms). So does chlorophyll, which is quite striking if one realizes that it absorbs most of the visible red rays. Both the pigment of the iris and the chlorophyll protect their bearers from the harmful heat rays by reflecting them.

P. C. KRONFELD.

Neurology

INFANTILE TABES. G. VON GROMAN and A. MAGALHÃES, Arch. de oftal. de Buenos Aires **10:** 336 (April-May) 1935.

Blindness with atrophy of the optic nerve developed rapidly in a child 9 years of age with diminution of the patellar reflex and positive Wassermann reactions of the blood and cerebrospinal fluid. The authors diagnose the condition as infantile tabes and discuss the symptoms, differential diagnosis and pathologic changes.

C. E. FINLAY.

A RARE FORM OF MYOTONIC DYSTROPHY WITH CATARACT. N. K. MONYUKOVA, Sovet. vestnik oftal. **6:** 669, 1935.

A man aged 27 gave a history of poor vision in both eyes since childhood. Ten years previously he had three operations on the left eye. Examination revealed in the right eye a zonular cataract, with vision equal to the counting of fingers, and in the left eye an aphakia with a secondary membrane and an irregularity of the pupil due to posterior synechiae. The vision with correction was 0.2.

The neurologic diagnosis was a combination of paramyotonia with myotonic atrophic dystrophy. The dysfunction of the endocrine glands manifested itself in hyperesthesia, baldness, sexual impotency, debility, atrophy of teeth, etc.

The interesting feature was that, although a complete intracapsular extraction was done on the right eye, whitish débris of the capsule was noticed in the wound a few days after the operation. Monyukova believes that as a result of the degenerative process in the capsule in this disease some of its fibers are separated and are incarcerated in the wound. Because of changes in the retina the vision could be improved only to 0.4.

O. SITCHEVSKA.

Ocular Muscles

STRABISMUS OF UNUSUAL ORIGIN WITH MEDICAL CURE. A. TERSON, Bull. Soc. d'opht. de Paris, January 1935, p. 22.

The patient was a 9 year old girl. Her father had died of pneumonia three days previous to her trouble. On examination she revealed redness and pain in the right eye. Two days later an internal deviation of 40 degrees was noted. The condition was apparently a paralysis of the sixth nerve. However, the external rectus was able to turn the right eye out with no signs of a saccadic movement. With a low degree of myopic correction visual acuity was normal for either eye. Outside of being highly emotional the child had no physical or mental disabilities. Bromides and potassium iodide were prescribed. Two pairs of glasses were worn, the first having a half moon opacity for the right eye to suppress the diplopia, the second with correction for the right eye and a totally opaque glass for the left. For a week there was no change in the condition. After the fourth week the deviation was only 15 degrees. In two months' time no deviation could be recorded. Other cases are cited showing that in some similar states an immediate operation has been given credit for a good cure when medication and time might have produced like results.

L. L. MAYER.

A Case of Latent Nystagmus. P. Bailliart, Bull. Soc. d'opht. de Paris, February 1935, p. 66.

In June 1932 Dupuy-Dutemps presented a patient with "nystagmus determined by the exclusion of one eye." In October 1932 Bailliart and his preceptor Rossano presented three cases of latent nystagmus. Others have been observed since then, but the case which is now reported is of unusual interest because Fromaget has essayed for the first time to give an explanation of the condition.

A woman of 48 years consulted Bailliart, complaining of general and bizarre eye troubles. There was a feeling of vertigo at times when she looked at an object. On occasions this was so bad that she had fallen in the street. The right eye diverged 40 degrees and was amblyopic, with a visual acuity of 1/20. With the two eyes open there was no evidence of nystagmus, and the vision was 8/10. In looking to the right there was slight shaking, but in looking to the left there was none. If the right eye was occluded, nystagmus was marked on looking to the right but disappeared on looking to the left. The nystagmus was always horizontal. If the good eye was occluded, the right eye had a rapid nystagmus with long excursion on looking to the right, which decreased in speed and amplitude on looking to the left. With the occlusion of either eye a loss of equilibrium occurred and the patient usually fell to the floor. Physical examination including vestibular and laboratory tests yielded normal results. It was necessary to conclude that a congenital latent nystagmus existed independent of the vestibular apparatus. Operation to relieve the strabismus resulted in loss of the equilibrial difficulty, but a moderated nystagmus still persisted on occlusion of a single eye. Lafon has explained that "latent nystagmus is a congenital nystagmus which manifests itself when there is interference with convergence." Fromaget has accepted this explanation. It is thought that the intervention is in the supranuclear centers. If the coordination of eye movements is good no nystagmus appears.

L. L. Mayer.

Torsion Associated with Near Vision. H. Harms, Arch. f. Ophth. 133: 231 (Jan.) 1935.

The work on which this paper is based was done in Tschermak's department (of physiology) at the University of Prague. The author made most of the observations on himself. His eyes are practically emmetropic; he has exophoria of 3 degrees and cyclophoria of 2.5 degrees for distance. All the measurements were made on a special type of haploscope (the *Triederhaploskop* of Tschermak). The primary position was first determined for each eye and an image of a vertical light-filament formed on the meridian of the retina which functioned as the vertical one at that time. Then the eye or the eyes were focused on a nearby dot in the center of a revolvable black line. The line was rotated until it coincided with the after-image of the light-filament. The position of the black line indicated the amount of conclination or disclination which was associated with the impulse to near vision. Besides this, the subjective vertical direction was determined in the primary position and again under the conditions of near vision.

If the near objects were just dots and the convergence was asymmetrical, the author's eyes made a disclinatory movement, which was more pronounced in the left eye. The amount of disclination paralleled the impulse to convergence. If the two identical near objects consisted of horizontal and vertical lines which demanded exact fusion, no disclinatory movement took place. Objects which determined not only the position of the visual axis but also the orientation of the retina apparently elicited corrective conclinatory movements which offset the usual disclination associated with near vision.

The subjective vertical direction also made a disclinatory movement which was only less pronounced than the actual movement of the retina. In other words, the retinal meridian the stimulation of which produced the subjective sensation of the vertical direction changed on moving the eyes from the primary position to a position of near vision.

The paper shows very strongly the influence of the great maestro A. Tschermak on the field of physiologic optics.

P. C. KRONFELD.

Operations

PRINCIPLES OF MODERN SURGERY IN OPHTHALMOLOGY. J. M. WHEELER, Am. J. Ophth. **17**: 683 (Aug.) 1934.

This article does not lend itself to abstracting. Wheeler discusses the surgery of retinitis pigmentosa, iridotomy, iridodialysis, cyclodialysis with iridectomy in glaucoma, pulsating exophthalmos, exophthalmos in exophthalmic goiter, corneal grafting and detachment of the retina. His discussion is general, interesting and interspersed with personal observations based on a wide experience.

W. S. REESE.

Orbit, Eyeball and Accessory Sinuses

PROGRESSIVE EXOPHTHALMOS IN THYROID DISEASE. M. GOLDENBURG, Am. J. Ophth. **17**: 692 (Aug.) 1934.

Goldenburg reports the case of a man, aged 68, in whom marked proptosis of both eyes developed following thyroidectomy. External canthotomy and incision of the conjunctivae with insertion of drains effected little improvement. Finally the right orbit was explored and some orbital fat removed for study. No definite tumor mass or abnormal tissues could be detected. The incised conjunctiva and subconjunctival tissues were hard and appeared to be infiltrated; a section was removed for study. The left orbit was likewise entered but explored with a probe. Both orbits were drained. Following this there was some improvement. Dehydration was then started, with gradual but consistent improvement. The author gives the following conclusions: "The exophthalmos associated with thyrotoxicosis may be divided into three stages: 1. Excessive stimulation of the sympathetic fibers with the production of moderate exophthalmos. 2. Over stimulation, with production of edema and increased exophthalmos. 3. Cellular reaction to the toxicosis with the production of marked edema and tissue changes resulting in fibrosis.

"It would appear that in the second and third stages, particularly the latter, a destructive toxin, probably other than that liberated by the thyroid, is responsible for the cellular reaction, infiltration, and tissue changes; that at this time there is an increase in volume of the orbital contents, with a limitation of the replaceability of the eyeballs; and that during this stage the eyeballs are seriously endangered and may be lost.

"If the cornea becomes involved, a decompression operation should be done at once; the simple method described being entirely adequate. The cornea must be fully protected by large Buller bandages and the various methods of dehydration suggested should be started at once."

W. S. Reese.

The Pupil

The Pupil Considered as a Revealer of the Functional Correlation Between the Somatic and Vegetative Systems. M. Monnier, Rev. neurol. **63:** 671 (May) 1935.

Monnier concludes that the iridopupillary apparatus is under the influence of a number of factors, both somatic and psychic. These phenomena may be grouped as belonging to pupillary movements or pupillary states, in other words, the constrictors and the dilators. The kinetic constriction is called "miosis" while the static constriction is termed "mioma." In the same manner dilatation when active is called mydriasis, and when passive, "mydriama." The miosis is a protective gesture. It not only is applicable in the local reactions of the iris, ciliary body, lids and tympanum to extraneous matter but may be induced by the vegetative system, for example, in circulatory changes and in respiration. It may be synergistic, and is observed as such in the adaptation of the eye for near vision (accommodation-convergence). The pupillary reaction may be combined, showing two phases: an initial miosis followed by a mydriasis. This is a transition type revealing the predominance of the sympathetic over the parasympathetic nervous system.

The mydriatic phases of the pupil are noted when general sensory excitation is evidenced. It is always indirect, is never isolated, is psychomotatory and appears when the organism is reacting to stimuli in other ways. In prolonged dilatation or "mydriama," an energetic functional disposition reveals the predominance of the sympathetic over the parasympathetic nervous system.

The pupillary reactions are grouped under two headings: kinetic and static. Each of these may have excitations of the order of somatic or vegetative reactions. A bibliography is included.

L. L. Mayer.

Unilateral Reflex Mydriasis in Cats During Labor and Diseases of the Uterus. P. Mintscheff, Arch. f. Ophth. **133:** 138 (Nov.) 1934.

Mintscheff is a veterinarian at the University of Sofia in Bulgaria. In thirty-two cats he found reflex dilatation of one pupil during parturition. The dilatation began about the time of the separation of the fetal

placenta and ceased from one to two days after delivery. Cats with inflammatory diseases of the uterus also occasionally showed dilatation of one pupil. He found that pressure on the diseased portion of the uterus in some cases elicited unilateral mydriasis or made anisocoria, if present, more pronounced. Thus the reflex mydriasis served for localizing diagnosis in the abdomen.

P. C. KRONFELD.

Physiology

ENTOPTIC PHENOMENA ASSOCIATED WITH RETINA. C. R. MARSHALL, Brit. J. Ophth. **19:** 177 (April) 1935.

This lengthy and interesting consideration of entoptic phenomena associated with the retina cannot be satisfactorily abstracted. The subject is treated under the heads of retinal vessels and macula, chorio-capillary circulation, retinal pigment, luminous darting points, pressure phosphenes, self-light of the eye, and the seat of vision for form.

The author gives the following summary:

"The rods and foveal cones can look backward and observe the retinal pigment and chorio-capillary circulation.

"On rare and chance occasions the retinal pigment may be seen under different and high magnifications.

"The difficulties of observation and different appearances are attributed to varying positions of the outer segment, possibly caused by greater or less relaxation of the myoid of the inner segment, of the rods and cones.

"The outer segment is regarded as the seat of transformation of light energy to nervous excitation.

"The darting luminous points are attributed to red blood corpuscles in the capillaries of the inner nuclear layer.

"The self-light of the eye is probably associated with energy emanating from the pigment particles of the retina and from the retroretinal circulation.

"Most unexplained entoptic appearances associated with the retina, except those which may be due to or influenced by the mentality, especially the powers of pictorial conception, of the individual, are explained as out-of-focus presentations of normal structures in or adjoining the retina."

A bibliography is included in the article.

W. ZENTMAYER.

AN ADDITIONAL COMPONENT OF THE CONVERGENCE-ACCOMMODATION REFLEX. H. COHEN, Brit. J. Ophth. **19:** 267 (May) 1935.

Hitherto the convergence-accommodation reflex has been described as possessing two clinically observable components: (1) convergence of the eyes due to the action of the internal recti and (2) contraction of the pupil. Observation shows that a third component must be added, namely, (3) relaxation of the levator palpebrae superioris with consequent lowering of the upper lid. The loss of this third component of the reflex is one of the earliest ocular signs in chronic encephalitic parkinsonism and hyperthyroidism.

W. ZENTMAYER.

RELATION BETWEEN THE STATE OF ADAPTATION AND THE SENSITIVITY OF THE EYE TO ELECTRIC STIMULI. A. J. BOGOSLOVSKY, Arch. f. Ophth. **133:** 105 (Nov.) 1934.

Weak galvanic currents, if sent through the eye, produce a phosphene of very low brightness. A trained observer can determine the threshold for this type of stimulation with sufficient accuracy. One nonpolarizable silver electrode is pressed against one finger. The other silver electrode (cathode) is soldered into a glass cuvette which contains cotton soaked with physiologic solution of sodium chloride. This cuvette is pressed against the lids of the closed eye. Under these conditions a current of from 18 to 20 micro-amperes (1 micro-ampere $= 1.10^{-3}$ milliamperes $= 1.10^{-6}$ amperes) usually produces the threshold phosphene. Bogoslovsky has determined the absolute threshold for galvanic stimulation in varying states of adaptation and found that during dark adaptation the sensitivity to electric stimuli drops at first rapidly, later on more slowly. The counterexperiment is done as follows: The person tested fixates on a white surface which reflects a measured amount of light. After ten minutes of this adaptation to light, the light is turned off. About one minute later the after-images have ceased sufficiently to permit the determination of the threshold for electric stimuli. Thus Bogoslovsky has found that during adaptation to light the sensitivity to electric stimuli rises to a maximum and then drops. These results confirm the important rôle played by central factors in the visual processes.

P. C. KRONFELD.

INFLUENCE OF PREVIOUS VISUAL STIMULI ON DARK ADAPTATION. E. N. SEMENOVSKAJA, Arch. f. Ophth. **133:** 155 (Nov.) 1934.

The plan of these experiments was as follows: The persons tested were exposed to a total light intensity of 2 lux for fifty minutes. Then both eyes received red or white stimuli of the same brightness ("prestimuli") for ten minutes. The dark adaptation was then studied by means of an adaptometer of the type described by Foerster. The red stimulus was furnished by a filter which transmitted no rays of a wavelength under 640 millimicrons. In the experiments with red "prestimuli," the sensitivity to light rose more rapidly and to a higher level than in the experiments with white "prestimuli." Binocular "prestimuli" raised the subsequent sensitivity more than monocular ones.

P. C. KRONFELD.

Refraction and Accommodation

RISING FRONT BIFOCALS. F. A. WILLIAMSON-NOBLE, Brit. J. Ophth. **19:** 165 (March) 1935.

To overcome the disadvantages of the ordinary bifocal glasses by reason of which reading matter has to be held well below the horizontal plane in order to be clearly visible and the wearer is handicapped in going down stairs, the author has devised an adaptation of the "scholar's bridge." This is attached to the spectacle frame by two sleeves in which it can slide up and down. When the glasses are in the low position they

are indistinguishable in appearance from an ordinary pair, but when they are raised the double bridge is apparent. A second type was made, of tortoise shell, which rested on the bridge of the nose, the two different heights being obtained by revolving the bridge on a decentered axis. The conspicuously thick nosepiece is perhaps a disadvantage.

The article is illustrated.

W. ZENTMAYER.

RELATION BETWEEN REFRACTION AND DEVELOPMENT OF THE BRAIN. F. STOCKER, Arch. f. Ophth. **133:** 131 (Nov.) 1934.

For many years Stocker has been consulting ophthalmologists for the *Hilfsschulen für Minderbegabte* of Lucerne. These are special schools for children who, on the average, possess not enough intelligence to attend the schools for normal children with any degree of success. These children, however, are not idiots. For a long time Stocker has felt that among these children high degrees of hyperopia, amblyopia and strabismus convergens are more frequent than among the pupils in schools for normal children. He has now studied this question with statistical methods and finds that in the *Hilfsschulen* the average degree of hyperopia as well as the number of highly hyperopic children parallels the degree of mental debility.

P. C. KRONFELD.

OPTICAL ELEMENTS IN ANISOMETROPIA AND ISOMETROPIA. E. TRON, Arch. f. Ophth. **133:** 211 (Jan.) 1935.

Tron's material consists of twenty-two cases of anisometropia in which the optical elements were determined as follows: refraction by retinoscopy and subjective test, both under atropine cycloplegia; the curvature of the cornea with the ophthalmometer; the depth of the anterior chamber, the curvature of both surfaces and the thickness of the lens with the ophthalmophakometer, the axial length by computation. Differences between the refractive powers of the corneas were present in fifteen cases and varied from 0.26 to 1.42 diopters. Differences between the refractive powers of the lenses were present in fourteen cases and varied from 1.07 to 8.52 diopters. The axial lengths were different in nineteen cases; the differences varied from 0.83 to 7.05 mm. Anisometropia can be the result of three possible combinations, viz.: (*a*) equal axial lengths but unequal refractive powers, (*b*) equal refractive powers but unequal axial lengths and (*c*) unequal axial lengths and refractive powers. The first should be called "refraction anisometropia," the second "axial anisometropia" and the third "anisometropia of mixed origin." In Tron's material the mixed type is most frequent.

P. C. KRONFELD.

Retina and Optic Nerve

THE VASOMOTOR SYSTEM IN RETINAL AND CEREBRAL VASCULAR LESIONS. D. KRAVITZ, Am. J. Ophth. **17:** 741 (Aug.) 1934.

Kravitz remarks the importance of vascular spasms in the brain and retina. He discusses the question of whether the cerebral and retinal

vessels are under sympathetic control and cites various works tending to show such control. Attention is called to the susceptibility of brain tissues to loss of blood supply. Three cases are reported and commented on, two of spasm of the retinal and one of spasm of the cerebral vessels. Two of the patients recovered completely; one of these had hemianopia.

W. S. REESE.

HYALINE BODIES ON THE DISCS. F. C. PLUMMER, Brit. J. Ophth. **19:** 215 (April) 1935.

The interesting feature of the case was the extent and prominence of the hyaline bodies which covered the surface and overlapped the margins of the disk in both eyes.

The patient was a boy aged 10 years. The error of refraction was + 2.5 in each eye. Vision was 6/6.

W. ZENTMAYER.

ISCHEMIA OF THE RETINA FOLLOWING UTERINE HEMORRHAGES. P. BONNET and E. BLANC, Bull. Soc. d'opht. de Paris, January 1935, p. 52.

A woman of 34 had a miscarriage during the third month of gestation. Free hemorrhage continued for six hours without intermission. Two days later she complained of a blur before the left eye. Following an injection of serum subcutaneously, perception of light was lost in the left eye. The right eye was unaffected. The pupil of the left eye was fixed in mydriasis; there was no reaction to direct light, but there was reaction to consensual light. The fundus simulated the picture of embolus of the central artery. Two weeks later vision was 1/6 with a visual field reduced to the fixation point. The red blood corpuscle count at this time was 3,760,000. The Wassermann reaction was negative. The authors call attention to the rarity of uniocular involvement, the red spot in the macula included in the picture of arterial embolism and the subicteric tint of the patient's skin, which points to the liver as a pathologic factor.

L. L. MAYER.

PAPILLORETINAL EXUDATE OF DENTAL ORIGIN. P. BONNET and J. BUSSY, Bull. Soc. d'opht. de Paris, January 1935, p. 56.

Bonnet and Bussy report on a patient, aged 18 years, who suddenly had a lowering of vision of the right eye. On examination a positive central scotoma was demonstrable, while the fundus in the macular area presented a star figure as often seen in the retinitis of nephritis. General examination failed to reveal anything of importance besides six infected devitalized teeth. In spite of the fact that the authors did not feel that the condition of the teeth could account for the retinal lesion the teeth were removed. There was a gradual diminution in the completeness and size of the central scotoma, and the lesions of the fundus disappeared after a short time. The visual acuity increased to 1/3. Some degeneration in the macular area must have occurred. The case is presented in order to get other opinions.

L. L. MAYER.

SECRETORY FUNCTION OF THE RETINAL PIGMENTED EPITHELIUM IN RETINITIS EXUDATIVA EXTERNA (COATS). Y. KOYANAGI, Arch. f. Ophth. **133:** 173 (Jan.) 1935.

Koyanagi reports two case of retinitis exudativa externa. In the first case the eye was removed because of painful absolute secondary glaucoma. In the second case the clinical diagnosis was glioma retinae. Anatomically both eyes exhibited the typical picture of retinitis exudativa externa. Sections stained by the hematoxylin-eosin method or after Van Gieson's method did not bring out any unusual details. Koyanagi used Heidenhain's iron-hematoxylin stain and found inside the cells of the pigmented epithelium of the retina granules of "secretion" which stained exactly like the subretinal exudate. This and other pathologic findings make him believe that the subretinal exudate in retinitis exudativa externa is secreted by the pigmented epithelium.

P. C. KRONFELD.

LESIONS OF THE MACULAE, COMBINED WITH A HAIR ANOMALY, IN TWO BROTHERS. H. WAGNER, Arch. f. Ophth. **134:** 74 (May) 1935.

In two brothers the vision had been slightly impaired, according to the history, only lately. The maculae exhibited black spots surrounded by "pepper granules." The hair of the scalp was of the lanugo type. Wagner considers the anomaly of the eye as hereditary and perhaps congenital and compares it to the well established types of familial degeneration of the macula.

P. C. KRONFELD.

Trachoma

THE EFFECT OF DIET AND VITAMINS ON TRACHOMA. C. E. RICE, R. SORY, J. E. SMITH, P. E. FAED and A. A. DRAKE, Am. J. Ophth. **17:** 735 (Aug.) 1934.

The authors give the following conclusions: "(1) Thirty patients with trachoma were studied for varying periods to determine the effect of diet and vitamins on the course of the disease. (2) There is no evidence that a balanced diet supplemented with cod-liver oil by mouth affected the course of trachoma in the untreated eyes of eighteen patients kept under observation for varying periods of time. Neither is there evidence that a balanced diet supplemented by cod-liver oil, both by mouth and intramuscularly, and Brewer's yeast affected the course of the disease in twelve trachomatous patients during the time they were kept under observation."

W. S. REESE.

RICKETTSIA-LIKE BODIES IN TRACHOMATOUS TISSUES. A. BUSACCA, Arch. f. Ophth. **133:** 41 (Nov.) 1934.

Most of the contents of this paper have been published in the transactions of the International Congress of Ophthalmology in Madrid. Busacca describes small (less than 1 micron) oval bodies which occur in pairs surrounded by a light staining area. These bodies stain dark brown with Jahnel's silver nitrate method and dark red with Giemsa's.

They also take victoria blue well. They occur intracellularly and extracellularly, and in the epithelium as well as in the granulation tissue taken from trachomatous patients who have not been treated for some time. He believes that these bodies are not artefacts, chondriosomes or "azurophil granules." The normal conjunctiva or that from patients with chronic, follicular or phlyctenular conjunctivitis do not contain the bodies. Nor have they been found in scrapings from other pathologic tissues. They can be differentiated easily from the inclusion bodies of Halberstädter and Prowazek and also from Lindner's elementary bodies. They may be identical with the micro-organisms which were described by Rötth (*Arch. f. Ophth.* **128:** 381, 1932). Busacca believes that they represent micro-organisms of the Rickettsia group. He has inoculated mice, guinea-pigs and rabbits with material obstained from trachomatous tissue. The results of these experiments, as described in the paper, do not look like specific effects to me. P. C. KRONFELD.

INOCULATION OF RABBITS WITH MATERIAL GAINED FROM TRACHOMA: FOLLICLE-FORMING AGENTS. A. VON SZILY, Klin. Monatsbl. f. Augenh. **94:** 1 (Jan.) 1935.

Von Szily refers to his experimental inoculations of chickens and monkeys with material gained from human sympathetic ophthalmia (*Klin. Monatsbl. f. Augenh.* **93:** 145 [Aug.] 1934; abstr., ARCH. OPHTH. **13:** 669 [April] 1935). One of the discoveries was that of symptoms of reaction in the uvea, the orbit and the optic tract of the inoculated eye and of genuine lymph follicles in the orbit of the other eye.

The technic of inoculation with the trachomatous material resembled that with the material of sympathetic ophthalmia. Rabbits were used. Particles of trachomatous conjunctiva were ground in a mortar with physiologic solution of sodium chloride, and 0.1 cc. of a dilution was injected into the vitreous. The result of the injection was called positive if genuine lymph follicles developed intra-ocularly, e. g., in the vitreous and the uvea. The result was considered negative if the choroid was slightly or not at all infiltrated some weeks after the injection, although the retina might have become detached by shrinking of exudations in the vitreous. When the result of the injection was positive the inflammation progressed, the number of follicles increased, connective tissue formed, and phthisis of the eyeball developed. Follicles, however, sometimes disappeared, suggesting spontaneous recovery with scar formation. A score of excellent photomicrographs show the follicles in the vitreous, the choroid, the conjunctiva and other areas of the eyeball. The follicles were of a typical trachomatous type no matter in which portion of the eyeball they developed. They occurred chiefly in the vitreous, contrary to the follicles observed after the inoculations with material of sympathetic ophthalmia, which showed decided affinity to the choroid. The trachomatous follicles sometimes attained considerable size, and they had a tendency to unite in groups. Their relation to Prowazek's bodies could not be established. Von Szily thinks that a group of hitherto invisible "follicle-forming agents" play a rôle in the formation of follicles after inoculation of animals with material of human sympathetic ophthalmia and of trachoma. K. L. STOLL.

RESULTS OF A NEW TREATMENT IN TRACHOMA. A. GARDILČIČ, Klin. Monatsbl. f. Augenh. **94**: 262 (Feb.) 1935.

Gardilčič used alkalizing remedies in trachoma for five years, after isotonic buffer solutions of sodium phosphate with a p_H of 7.5 to 8.5, instilled or injected under the conjunctiva, had produced merely transient relief. After this he employed oxidative preparations, e. g., benzoylperoxide with organic and inorganic combinations of zinc, potassium, calcium, sodium, manganese, silver and so forth, which free chlorine. The combination has to come in close contact with every portion of the conjunctiva while the cornea is protected by a contact glass. The results were doubtful. Heyden's chloramine caused too much irritation. Irritation was slight when sodium hypochloride was used, which frees chlorine and has an alkaline component; the latter was instilled in solutions of 0.25 to 0.5 per cent or used for massage in concentrations of 1 per cent. The result was as good as that of surgical solution of chlorinated soda (Dakin's solution) except after protracted use. Further research was made with combinations of heavy metals which free chlorine and which produce concentration of the colloid. The combinations were selected so as to have an antiacidotic component and to unite their oxidative and alkalinizing properties with the action of the heavy metals. These three factors are thought to influence beneficially even patients with trachoma complicated with other bacterial infections and scrofulosis. The best results were obtained by massage with salves containing alkaline combinations of copper, zinc, mercury, gold or silver. These combinations are not stable; their components have to be prepared independently and are mixed before use.

Active chlorine in these combinations is the best oxidizing factor. It yielded results which could not be obtained with other remedies. Recurrences of trachoma were not observed within from one to three years after the treatment. Photographs of patients, demonstrated by the author, prompted J. Meller and K. Lindner to comment on the splendid results of this therapy, considering the duration of the treatment.

K. L. STOLL.

Tumors

CASE OF BILATERAL EPITHELIOMA OF THE LIMBUS IN A BOY OF FIVE. A. H. LOWTHER, Brit. J. Ophth. **19**: 264 (May) 1935.

The patient was a Tamil boy aged 5 years. Following acute conjunctivitis four years previously extensive corneal opacities formed, leaving the eye inflamed and troublesome. In each eye there was a raised grayish wartlike growth astride the limbus on the temporal side in the horizontal diameter. The growth in the right eye was removed and proved to be an epithelioma. Later the tumor in the left eye was excised, and the base of each growth was thoroughly cauterized. Eight months later there was no evidence of recurrence.

W. ZENTMAYER.

CHOROIDAL METASTASIS OF A THYROID TUMOR. L. VENCO, Ann. di ottal. e clin. ocul. **63**:401 (June) 1935.

A man of 59 had undergone three operations for a tumor of the thyroid which was diagnosed as an adenocarcinoma. Two years after

the last operation poor vision was noticed in the left eye. At his first examination four months later vision in this eye was reduced to perception of light, and in the vitreous a gray mass was seen which was obscured by opacities of the media. A detachment of the retina was present, below, with no retinal tear visible. Puncture of the sclera was performed, revealing in the subretinal fluid a few cells with clear cytoplasm and eccentric nuclei. The vitreous became clearer, and a yellowish-red mass was seen covering the disk. The eye was enucleated, and a round tumor was seen arising from the choroid at the posterior pole, covering the nerve. It was composed of alveoli resembling thyroid tissue and containing a substance giving the characteristic staining reactions of colloid. No pigment was present in the tumor tissue proper. Sections of the material removed from the neck two years before showed a tumor of similar structure, which Venco classifies as a proliferating struma of the Langhans type. The literature not only of similar tumors but of metastatic choroidal tumors in general is reviewed. Only five other cases were found in which choroidal metastasis from a thyroid tumor occurred. All of these but one involved the left eye, a fact analogous to that noted for other metastatic tumors, and all but two were in women. The slow course of the metastasis is emphasized, fourteen years having passed since the first operation in the author's case and a similar length of time in other cases referred to.

S. R. GIFFORD.

ORBITAL NEURINOMA. CARLOS S. DAMEL and R. RODRÍGUEZ VILLEGAS, Arch. de oftal. hispano-am. **35:** 1 (Jan.) 1935.

After mention of twelve cases reported in the literature under the names "orbital neurinoma," "orbital neuroma," "orbital glioma" and "orbital neurofibroma" Damel and Rodríguez attribute the difference in denomination to the authors' respective inclinations toward a conjunctival or a nervous origin (mesodermic or ectodermic) or to a localization of the site of origin to an interannular segment of a nerve fiber or to the supporting structure (peripheric neuroglia represented by Schwann cells), the majority favoring a mesodermic or glial origin.

The authors report the clinical and operative features of a case in which the Krönlein operation was successful. The tumor had the following characteristics: A fascicular and poorly vascularized structure constituted the mass. In the growing portion this structure was not so apparent; one found isolated islets of fatty tissue arranged in columns made up of cells charged with lipoids and neutral fats. At some points a schematic structure of new nerve fibers was to be found, with lengthened ovoid nuclei in a fine elementary meshwork with one or two nucleoli, the cell body being prolonged into a meshwork of extremely delicate fibrils longitudinally arranged.

The operative features permit an elimination of any optic or orbital motor nerve as the site of origin. The authors fix the origin in one of the ciliary nerves.

They are inclined to consider that in the majority of cases it is feasible to remove the tumor through a transconjunctival approach without a Krönlein osteoplastic resection, which always leaves an ugly scar.

C. E. FINLAY.

Society Transactions

ROYAL SOCIETY OF MEDICINE, LONDON, SECTION OF OPHTHALMOLOGY

Friday, Oct. 11, 1935

MR. RANSOM PICKARD, C.B., M.S., *President*

CYSTIC SWELLING OF THE RETINA. WING COMMANDER P. C. LIVINGSTONE.

An officer in the Royal Air Force said that the vision in his right eye was failing. At that time the vision in the eye was 6/18 minus, and there was a patch of active choroiditis situated just above the disk and temporally. He had an eosinophilia of 9 per cent. The condition slowly cleared up after fifty-three days' treatment in the hospital, and he returned to his duties as an aviator. Later a cyst appeared, which has remained unchanged for the past six to eight months.

Sir John Parsons and Sir William Lister saw the patient in consultation. At that time there was 14 to 16 diopters of swelling. An investigation from the point of view of the possible presence of a cysticercus revealed none.

DISCUSSION

MR. RANSOM PICKARD: The fact that the man was found to have 9 per cent eosinophilia increases the suspicion that he has a parasitic cyst.

MR. A. C. HUDSON: The possibility of this being a sarcoma ought to receive careful consideration. There is present a fairly extensive detachment of the retina in the upper part of the retina, a fact which favors the condition's being sarcoma rather than any form of simple cyst. If it is possible to transilluminate so far back, it should give valuable information. If I had the management of this case I should remove the eye. The lesion is very near the optic nerve, and if it is sarcoma it will soon reach that nerve.

WING COMMANDER P. C. LIVINGSTONE: Sir John Parsons thought of sarcoma as one possibility but considered that the history of the primary inflammation was against sarcoma. Sir William Lister thought that this was neither a cysticercus nor a sarcoma, but that it was purely cystic.

HYPERPHORIA ASSOCIATED WITH OVERACTION OF THE INFERIOR OBLIQUE MUSCLE. TREATMENT BY RECESSION OF THE ORIGIN OF THE MUSCLE. MR. A. RUGG-GUNN.

A 10 year old boy had an upshoot of the right eye when he looked to the left. After correction (low mixed astigmatism) the vision in the right eye was 6/9. In the primary position the eyes appeared to be about level, but with the Maddox rod there was at least 20 diopters

of hyperphoria. All the movements were full and coordinated except that on looking to the left the right eye showed marked overactivity of its inferior oblique muscle.

An incision was made along the inner part of the lower orbital margin, and the tissues down to the periosteum were separated. A strabismus hook passed along the orbital floor from the outer side picked up the muscle at its origin. The muscle was grasped by a Prince forceps, cut from its origin close to the periosteum, and a single catgut stitch inserted. The muscle was reattached to the periosteum by means of the catgut suture along the line of its axis about one quarter inch (about 0.64 cm.) posterior to its original attachment. Flat retractors were used to displace the orbital contents. On reexamination ten weeks after the operation, there was no sign of the former upshoot of the right eye when the boy looked to the left.

Temple Smith, of Sydney, has written a paper dealing with the treatment of conditions of this type by myotomy of the inferior oblique muscle. The inferior oblique muscle and the superior rectus muscle of the opposite side are complementary muscles, and in the position of adduction the main elevator muscle is the inferior oblique. Temple Smith suggested that the primary cause of this syndrome is weakness of a superior rectus muscle. Weakness of one member of the pair causes overaction of the other, leading to hypertrophy, which causes an accentuation of the diplopia when the eye is in the position of adduction.

Bipolar Electrolytic Treatment of Detachment of the Retina.

Mr. Cole Marshall.

The amount of choroiditis induced by cathode electrolysis by the method of Vogt can be varied according to the time of application and directly according to the strength of the current. The distance between the points can be easily varied. After preparing the sclera in the usual way and marking out the position of the tear, the anode, which can be in the shape of a Larsson ball, is placed on the surface of the eyeball a few millimeters from the point at which the punctures are to be made. The current is turned on, and the long needle is pushed through the sclera deep enough to reach the retina. The needle is kept in no longer than one second. The aim is to surround the tear with punctures as well as to puncture the actual area of the tear.

The following advantages for the method are claimed by Vogt: 1. Catholysis with small current does less damage to ocular tissues than ignipuncture, and the electrolytic needle does not harm the retina and produce artificial holes as does the diathermy needle. 2. Other methods produce scar membranes, secondary holes, opacities of the lens and optic neuritis. 3. A very small amount of vitreous is lost in comparison with that lost following other operations. 4. It can be used as a method of localization since fine bubbles, looking like frog spawn, can be seen at the point of the cathode. 5. The method is simple and harmless, and, if the eye has been prepared on the previous day and the cornea is kept clear during the operation, the work is finished in a short time. Vogt did not use any corneal anesthetic; he

depended on the deep injections. 6. The method is very successful in old people and in those who have old detachments.

Binocular Vision in Everyday Life, with a Description of the Binocular Gage. Wing Commander P. C. Livingstone.

During an investigation into the causes of eyestrain in government workers at the department of weights and measures, it was found that all those engaged in buret comparisons had heterophoria, some to such a degree as to affect their speed of work and their efficiency. Similarly, at the kodak works, among those employed in the manufacture of key-winders, the binocular powers were subjected to a constant strain of from 2 to 3 meter angles of convergence, with much added concentration. But the largest number of cases were found in those who came from the electrical and wireless school and in the department of apprentice clerks. In many instances the breakdown of convergence was the actual cause of the eyestrain.

For measuring the muscle balance at near range I have designed an apparatus which I call the binocular gage. It is a wooden rule, 40 cm. long, with a slight cut down the center 30 cm. long, and with one end shaped to fit the face and rest against the infra-orbital margin. It is marked in centimeters and half-centimeters, measured from the anterior corneal surface. Going with it are three attachments: 1. A shield near the face to occlude either eye separately, used in estimation of monocular accommodation. This shield, when detached from the instrument, can be used also as a cover for the eye when the cover test is being carried out. 2. A vertical rod painted white and black in equal thirds, the black section being central. The black surface is offered to the subject when the convergence test is done and when the eyes are to be directed along the horizontal plane. 3. A small box-shaped attachment consisting of a front surface in which a cross is cut and a back space into which is fitted an ivory square with a black vertical line cut into its substance to measure subjective convergence. On the ivory square, on each side of the vertical line, three similar letters are printed which are used in measuring accommodation. The use of this gage is now a part of the routine ophthalmoscopic examination of flying staffs, for in a short space of time it is possible (*a*) to estimate the convergence power in two ways, (*b*) to discover the master eye, (*c*) to examine the accommodation and (*d*) to perform the cover test.

Book Reviews

Biological or Artery Flaps of the Face. By J. F. S. Esser. Price, $25. Pp. 176, with 420 illustrations. Monaco: Institut Esser de Chirurgie Structive, 1935.

Esser, the well known cosmopolitan Dutch specialist in plastic surgery, describes in a handsome volume, which contains four hundred and twenty illustrations, how plastic operations on the face may be performed.

His method is fundamentally different from that which is usually followed in transplantations with pedicles. The difference consists in the absence of skin in the pedicles of the flaps; on the other hand, stress is laid on the fact that the nutrition of flaps is largely dependent on the presence of arteries, veins, lymph vessels and nerves in the stalks. The presence of skin in the pedicle is considered a disadvantage. A cutaneous excess is ugly; moreover, when the stalk is twisted the skin may exert a pressure on the vessels. Eventually additional corrective operations are necessary. Thus, the presence of skin in the stalks is not economical, so far as trouble, time and skin are concerned; only the essential parts which were mentioned are necessary, and they may be surrounded by a small quantity of connective tissue. Short pedicles are preferred; there is, however, no objection to longer ones. The slenderness of the stalks makes possible a great mobility of the flaps. All the essential parts are situated in the neighborhood of the arteries. These are easily found and serve as guides in plastic operations; hence the name "artery flaps" besides that of "biological flaps."

This book is very important for ophthalmologists, as a great number of operations for restoring the eyelids and the orbit are described and profusely illustrated.

This is a splendid achievment. The reviewer cannot, however, agree with the author when he states in the preface that the results of corneal transplantation up to now have been so bad that the transplanted pieces, even when they remain alive, lose their transparency.

Esser enumerates, at the beginning of his book, many of the hospitals where he was appointed plastic surgeon. This and other peculiarities of the book are gladly accepted when one considers the value of this fundamental work and the fact that some advertisement is necessary for Esser's noble purpose. His ideal is to found, on an extraterritorial dominion, an international institute for plastic surgery; the purpose of such an institute would be the operation and reeducation for labor of mutilated persons from countries all over the world.

If any one can succeed in the establishment of such a great work it is certainly Esser, who will be enabled to do this by means of his large knowledge and his rich experience in plastic surgery and by his force of conviction which interests persons of every rank and station in his plans. This appears clearly from the list of the committee of honor, the Council of Administration and the Grand Council of the Esser Institute of Structive Surgery, in which the king of Italy, the president of France and of Spain, ministers, diplomats and many scholars took place with surgeons of different branches of their profession.

The book is published by the Esser Institute of Structive Surgery of Monaco; the profits of sale are destined for the international institute. The future will show whether Esser will succeed in realizing his dream.

VAN DER HOEVE (Leyden).

Directory of Ophthalmologic Societies *

INTERNATIONAL

International Association for Prevention of Blindness

President: Prof. F. de Lapersonne, 217 Faubourg St. Honoré, Paris.
Secretary-General: Prof. M. Van Duyse, Université de Gand, Gand, Prov. Ostflandern, Belgium.

International Ophthalmologic Congress

Secretary: Dr. Francisco Poyales, Olozaga 3, Madrid.
Place: Cairo. Time: 1937.

FOREIGN

British Medical Association, Section on Ophthalmology

President: Dr. A. J. Ballantyne, 11, Sandyford Pl., Glasgow, C 3.
Secretary: Dr. J. Ringland Anderson, 108 Collins St., Melbourne.

Ophthalmology Society of Bombay

President: Dr. D. D. Sathaye, 127 Girgaum Road, Bombay 4.
Secretary: Dr. H. D. Dastur, Dadar, Bombay 14.
Place: H. B. A. Free Ophthalmic Hospital, Parel, Bombay 12. Time: First Friday of every month.

Ophthalmological Society of the United Kingdom

President: Mr. R. Foster Moore, 53, Harley St., London, W. I.
Secretary: Miss Ida Mann, 7, Wimpole St., London, W. I.

Oxford Ophthalmological Congress

Master: Dr. C. G. Russ Wood, Hill House, Abberbury Rd., Iffley, Oxford, England.
Hon. Secretary-Treasurer: Dr. F. A. Anderson, 12 St. John's Hill, Shrewsbury, England.

Royal Society of Medicine, Section of Ophthalmology

President: Dr. Ransom Pickard, 31, East Southernhay, Exeter, England.
Secretary: Dr. A. Rugg-Gunn, 35, Harley St., London, W. 1.

Société Française d'Ophthalmologie

Secretary: Dr. René Onfray, 6 avenue de la Motte Picquet, Paris 7è.

Society of Swedish Ophthalmologists

President: Prof. F. Berg, Uppsala, Sweden.
Secretary: Dr. K. O. Granström, Södermalmstorg 4 III tr., Stockholm, Sö., Sweden.

German Ophthalmological Society

Secretary: Prof. A. Wagenmann, Heidelberg.

Chinese Ophthalmological Society of Peiping

President: Dr. P. H. Liu, Chi-Ming Eye Clinic, Ta Liu Pu Kau, Peiping.
Secretary: Dr. H. H. Feng, Peiping Union Medical College, Peiping.
Place: Peiping Union Medical College, Peiping. Time: Last Friday of each month.

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* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

Tsinan Ophthalmological Society

Chairman: Dr. Eugene Chan, Cheeloo University School of Medicine, Tsinan, Shantung.
Place: Cheeloo University School of Medicine. Time: Last Thursday of alternate months.

NATIONAL

American Medical Association, Scientific Assembly, Section on Ophthalmology

Chairman: Dr. John Green, 3720 Washington Blvd., St. Louis.
Secretary: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Place: Kansas City, Mo.: Time: May 11-15, 1936.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Frank E. Burch, 408 Peter St., St. Paul.
Executive Secretary-Treasurer: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: New York. Time: October 1936.

American Ophthalmological Society

President: Dr. Walter B. Lancaster, 520 Commonwealth Ave., Boston.
Secretary-Treasurer: Dr. J. Milton Griscom, 2213 Walnut St., Philadelphia.
Place: Hot Springs, Va. Time: June 1-3, 1936.

National Society for the Prevention of Blindness

President: Mr. William Fellowes Morgan, 50 W. 50th St., New York.
Managing Director: Mr. Lewis H. Carris, 50 W. 50th St., New York.

SECTIONAL

New England Ophthalmological Society

President: Dr. James J. Regan, 520 Commonwealth Ave., Boston.
Secretary-Treasurer: Dr. Benjamin Sachs, 483 Beacon St., Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

Pacific Coast Oto-Ophthalmological Society

President: Dr. H. G. Merrill, 3245 4th St., San Diego, Calif.
Secretary-Treasurer: Dr. Frederick C. Cordes, 384 Post St., San Francisco.
Place: Del Monte, Calif. Time: Spring, 1936.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. Francis A. Brugman, 509 Olive St., Seattle.
Secretary-Treasurer: Dr. Noble Dick, 1115 Terry Ave., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

Rock River Valley Eye, Ear, Nose and Throat Society

President: Dr. W. R. Fringer, 228 S. Main St., Rockford, Ill.
Secretary-Treasurer: Dr. W. H. Elmer, 321 W. State St., Rockford, Ill.
Place: Rockford, Ill., Janesville or Beloit, Wis. Time: Third Tuesday of each month.

Saginaw Valley Academy of Ophthalmology and Otolaryngology

President: Dr. Robert Griswell, 707 Washington Ave., Bay City, Mich.
Secretary-Treasurer: Dr. W. K. Slack, 308 Eddy Bldg., Saginaw, Mich.
Place: Saginaw, Mich., or Bay City, Mich. Time: Second Tuesday of each month, except July and August.

SIOUX VALLEY EYE AND EAR ACADEMY

President: Dr. L. H. Hohf, Yankton, S. D.
Secretary-Treasurer: Dr. J. C. Decker, Francis Bldg., Sioux City, Iowa.

SOUTHERN MEDICAL ASSOCIATION, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. William A. Wagner, 914 American Bank Bldg., New Orleans.
Secretary: Dr. O. M. Marchman, Medical Arts Bldg., Dallas, Texas.

SOUTHWESTERN MICHIGAN TRIOLOGICAL SOCIETY

President: Dr. O. B. McGillicuddy, 1908 Capitol Band Tower, Lansing, Mich.
Secretary-Treasurer: Dr. Maurice C. Loree, 120 W. Hillsdale St., Lansing, Mich.
Time: Third Thursday of alternate months.

WESTERN PENNSYLVANIA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Leslie R. Hazlett, 100 S. Main St., Butler.
Secretary-Treasurer: Dr. C. W. Beals, 41 N. Brady St., DuBois.

STATE

COLORADO OPHTHALMOLOGICAL SOCIETY

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. Edna M. Reynolds, 227, 16th St., Denver.
Place: Capitol Life Building, Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive.

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. George B. Garlick, 144 Golden Hill St., Bridgeport.
Secretary-Treasurer: Dr. Shirley H. Baron, 309 State St., New London.
Time: May, November.

EYE, EAR, NOSE AND THROAT CLUB OF GEORGIA

President: Dr. B. H. Minchew, 701 Elizabeth St., Waycross, Ga.
Secretary-Treasurer: Dr. Edward S. Wright, 1001 Medical Arts Bldg., Atlanta, Ga.
Place: Savannah. Time: May 12-15, 1936.

INDIANA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. J. R. Dillinger, French Lick.
Secretary: Dr. Frederick V. Overman, 705 Hume-Mansure Bldg., Indianapolis.
Place: Martinsville. Time: April 8, 1936.

IOWA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. F. W. Dean, 532, 1st Ave., Council Bluffs.
Secretary-Treasurer: Dr. O. L. Thorburn, 213½ Main St., Ames.

MICHIGAN STATE MEDICAL SOCIETY, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Secretary: Dr. D. R. Heetderks, 26 Sheldon Ave., S. E., Grand Rapids.

MINNESOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. H. E. Binger, 350 St. Peter St., St. Paul.
Secretary-Treasurer: Dr. Walter E. Camp, Medical Arts Bldg., Minneapolis.
Place: St. Paul. Time: May 1936.

MONTANA ACADEMY OF OTO-OPHTHALMOLOGY

President: Dr. George A. Lewis, Roundup.
Secretary: Dr. A. W. Morse, Phoenix Bldg., Butte.
Place: Billings. Time: February 1936.

NEW JERSEY STATE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY, OTOLOGY AND RHINOLARYNGOLOGY

Chairman: Dr. C. Coulter Charlton, 124 S. Illinois Ave., Atlantic City.
Secretary: Dr. H. L. Harley, 124 S. Indiana Ave., Atlantic City.

NEW YORK STATE MEDICAL SOCIETY, EYE, EAR, NOSE AND THROAT SECTION

Chairman: Dr. John F. Fairbain, 925 Delaware Ave., Buffalo.
Secretary: Dr. Walter S. Atkinson, 168 Sterling St., Watertown.

NORTH DAKOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Trygve Oftedal, 55½ Broadway, Fargo.
Secretary-Treasurer: Dr. F. L. Wicks, 514 6th St., Valley City.
Place: Jamestown. Time: May 1936.

OREGON ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. A. B. Dykman, Medical Dental Bldg., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

RHODE ISLAND OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

Acting President: Dr. Nathan Bolotow, 108 Waterman St., Providence.
Secretary and Treasurer: Dr. Gordon J. McCurdy, 122 Waterman St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. R. E. Houston, 103 E. North St., Greenville.
Secretary: Dr. J. W. Jervey Jr., 101 Church St., Greenville.

TENNESSEE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. W. W. Potter, 601 Walnut St., Knoxville.
Secretary-Treasurer: Dr. W. D. Stinson, 248 Madison Ave., Memphis.

TEXAS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. T. E. Fuller, 100 W. Board St., Texarkana, Texas.
Secretary: Dr. O. M. Marchman, 1719 Pacific Ave., Dallas.

UTAH OPHTHALMOLOGICAL SOCIETY

President: Dr. V. P. White, 143½ S. Main St., Salt Lake City.
Secretary-Treasurer: Dr. E. B. Fairbanks, Boston Bldg., Salt Lake City.
Time: Third Monday of each month.

VIRGINIA SOCIETY OF OTO-LARYNGOLOGY AND OPHTHALMOLOGY

President: Dr. Emory Hill, 501 E. Franklin St., Richmond.
Secretary-Treasurer: Dr. George G. Hankins, Medical Arts Bldg., Newport News.
Place: Richmond. Time: May 1936.

WEST VIRGINIA STATE MEDICAL ASSOCIATION, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. F. O. Marple, First Huntington National Bank Bldg., Huntington.
Secretary: Dr. J. E. Blaydes, First National Bank, Bluefield.

LOCAL

Academy of Medicine of Northern New Jersey, Section on Eye, Ear, Nose and Throat

President: Dr. B. E. Failing, 31 Lincoln Park, Newark, N. J.
Secretary: Dr. A. Russell Sherman, 671 Broad St., Newark, N. J.
Place: 91 Lincoln Park South, Newark. Time: 8:45 p. m., second Monday of each month, October to May.

Atlanta Eye, Ear, Nose and Throat Society

President: Dr. Herschel Crawford, 478 Peachtree St., N. E., Atlanta, Ga.
Secretary: Dr. Stacy C. Howell, 384 Peachtree St., N. E., Atlanta, Ga.
Place: Academy of Medicine, 13 Queen's Park. Time: 8 p. m., last Thursday of each month.

Baltimore Medical Society, Section on Ophthalmology

Chairman: Dr. William M. Rowland, 906 Cathedral St., Baltimore.
Secretary: Dr. Mary L. Small, 18 W. Read St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

Brooklyn Ophthalmological Society

President: Dr. John H. Bailey, 855 St. Marks Ave., Brooklyn.
Secretary-Treasurer: Dr. George Freiman, 703 Grand St., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday in February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. Thurber LeWin, 112 Linwood Ave., Buffalo.
Secretary-Treasurer: Dr. I. J. Koenig, 40 North St., Buffalo.
Time: Second Thursday of each month.

Chicago Ophthalmological Society

President: Dr. Robert B. Blue, 25 E. Washington St., Chicago.
Secretary-Treasurer: Dr. Thomas D. Allen, 122 S. Michigan Ave., Chicago.
Place: Medinah Michigan Avenue Club, 505 N. Michigan Ave. Time: Third Monday of each month from October to May.

Cleveland Academy of Medicine, Section of Ophthalmology and Otolaryngology

Chairman: Dr. A. D. Ruedemann, 2020 E. 93d St., Cleveland.
Secretary: Dr. Fred W. Dixon, 1029 Rose Bldg., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

Cleveland Ophthalmological Club

Chairman: Dr. A. B. Bruner, 629 Euclid Ave., Cleveland.
Secretary: Dr. M. W. Jacoby, Hanna Bldg., Cleveland.

College of Physicians, Philadelphia, Section on Ophthalmology

Chairman: Dr. John Milton Griscom, 2213 Walnut St., Philadelphia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

Columbus Ophthalmological and Oto-Laryngological Society

Chairman: Dr. F. W. Thomas, 327 E. State St., Columbus, Ohio.
Secretary-Treasurer: Dr. H. D. Emswiler, 370 E. Town St., Columbus, Ohio.
Place: Athletic Club. Time: First Monday of each month.

Dallas Academy of Ophthalmology and Oto-Laryngology

President: Dr. F. H. Newton, Mercantile Bldg., Dallas, Texas.
Secretary: Dr. Maxwell Thomas, 1719 Pacific Ave., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Des Moines Academy of Ophthalmology and Otolaryngology

President: Dr. E. G. Linn, 604 Locust St., Des Moines, Iowa.
Secretary-Treasurer: Dr. Grace Doane, 614 Bankers Trust Bldg., Des Moines, Iowa.
Time: 7:45 p. m., third Monday of every month, September to May.

Detroit Ophthalmological Club

Chairman: Members rotate alphabetically.
Secretary: Dr. Raymond S. Goux, David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. A. W. Greene, 148 Barrett St., Schenectady.
Secretary-Treasurer: Dr. Joseph L. Holohan, 317 State St., Albany.
Time: Third Wednesday in October, November, March, April, May and June.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. T. L. Goodman, 602 W. 10th St., Fort Worth, Texas.
Secretary-Treasurer: Dr. Van D. Rathgeber, 1012 Medical Arts Bldg., Fort Worth.
Place: Medical Hall, Medical Arts Bldg. Time: 7:30 p. m., first Friday of each month except July and August.

Grand Rapids Eye, Ear, Nose and Throat Society

President: Dr. John H. McRae, 26 Sheldon Ave., S. E., Grand Rapids, Mich.
Secretary-Treasurer: Dr. Robert G. Laird, 307 Metz Bldg., Grand Rapids, Mich.
Place: Various local hospitals. Time: Third Thursday of alternating months. September to May.

Houston Academy of Medicine, Eye, Ear, Nose and Throat Section

President: Dr. R. M. Hargrove, 1202 Esperson Bldg., Houston, Texas.
Secretary: Dr. J. C. Dickson, 1617 Medical Arts Bldg., Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., second Thursday of each month from September to June.

Indianapolis Ophthalmological and Otolaryngological Society

President: Dr. J. C. Daniel, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, 23 E. Ohio St., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

Kansas City Society of Ophthalmology and Oto-Laryngology

President: Dr. H. B. Davis, 1101 Grand Ave., Kansas City, Mo.
Secretary: Dr. Byron Black, Professional Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

Long Beach Eye, Ear, Nose and Throat Society

Chairman: Dr. Clyde E. Harner, 110 Pine Ave., Long Beach, Calif.
Secretary-Treasurer: Dr. Paul T. Southgate, 704 Professional Bldg., Long Beach, Calif.
Place: Professional Bldg. Time: Last Wednesday of each month from October to May.

Los Angeles Society of Ophthalmology and Oto-Laryngology

President: Dr. Walter R. Crane, 756 S. Broadway, Los Angeles
Secretary-Treasurer: Dr. Pierre Viole, 1930 Wilshire Blvd., Los Angeles.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd., Time: 6:30 p. m., fourth Monday of each month from September to May, inclusive.

Louisville Eye, Ear, Nose and Throat Society

President: Dr. E. A. Leggett, 614 Breslin Bldg., Louisville, Ky.
Secretary-Treasurer: Dr. J. E. Craddock, 604 Breslin Bldg., Louisville, Ky.
Place: Jewish Hospital. Time: 6:30 p. m., second Thursday of each month from September to May, inclusive.

Medical Society of the District of Columbia, Section of Ophthalmology and Otolaryngology

Chairman: Dr. Arthur M. Zinkham, 815 Connecticut Ave., Washington.
Secretary: Dr. E. J. Cummings, 1835 I St., N. W., Washington.
Place: 1718 M St., N. W. Time: 8 p. m., third Friday of each month from October to April, inclusive.

Memphis Society of Ophthalmology and Otolaryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, 130 Madison Ave., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

Milwaukee Oto-Ophthalmic Society

President: Dr. J. J. Brook, 231 W. Wisconsin Ave., Milwaukee.
Secretary-Treasurer: Dr. Herbert G. Schmidt, 238 W. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6 p. m., second Tuesday of each month.

Minneapolis Ophthalmological Society

Chairman: Each member in alphabetical order.
Secretary: Dr. C. W. Rucker, 527 Medical Arts Bldg., Minneapolis.
Place: Hennepin County Medical Society rooms. Time: 6:30 p. m., fourth Monday of each month, October to May, inclusive.

Montgomery County Medical Society

Chairman: Dr. W. J. Blackburn, 663 Reibold Bldg., Dayton, O.
Secretary-Treasurer: Dr. F. J. Driscoll, 986 Reibold Bldg., Dayton, O.
Place: Van Cleve Hotel. Time: 6:30 p. m., bimonthly, first Tuesday from October to June, inclusive.

Montreal Ophthalmological Society

President: Dr. J. A. MacMillan, 1410 Stanley St., Montreal, Canada.
Secretary: Dr. A. L. Guertin, 410 Sherbrooke St., West, Montreal, Canada.
Time: Second Thursday of October, December, February and April.

NASHVILLE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. Kate S. Zerfoss, 119, 7th Ave., N., Nashville, Tenn.
Secretary-Treasurer: Dr. Fowler Hollabaugh, Doctors Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month from October to June.

NEW ORLEANS OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

President: Dr. R. H. Fisher, Chess and Checker Club, New Orleans.
Secretary-Treasurer: Dr. H. F. Brewster, 837 Gravier St., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month from October to June.

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

Chairman: Dr. John H. Dunnington, 30 W. 59th St., New York.
Secretary: Dr. LaGrand H. Hardy, 30 E. 40th St.,, New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

OMAHA AND COUNCIL BLUFFS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. John H. Judd, 107 S. 17th St., Omaha.
Secretary-Treasurer: Dr. W. A. Cassidy, 107 S. 17th St., Omaha
Place: Omaha Club, 20th and Douglas Sts., Omaha. Time: 6 p. m., dinner; 7 p. m., program; third Wednesday of each month from October to May.

PASSAIC-BERGER OPHTHALMOLOGICAL CLUB

President: Dr. S. T. Hubbard, 294 State St., Hackensack, N. J.
Secretary-Treasurer: Dr. T. A. Sanfacon, 80 Park Ave., Paterson, N. J.
Place: Paterson Eye and Ear Infirmary. Time: 9 p. m., last Friday of every month, except June, July and August.

PHILADELPHIA COUNTY MEDICAL SOCIETY, EYE SECTION

Chairman: Dr. Charles R. Heed, 1205 Spruce St., Philadelphia.
Secretary: Dr. Sidney L. Olsho, 235 S. 15th St., Philadelphia.
Time: First Thursday of each month from October to May.

PITTSBURGH OPHTHALMOLOGICAL SOCIETY

President: Dr. Edward B. Heckel, 500 Penn Ave., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

PITTSBURGH SLIT-LAMP SOCIETY

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: 121 University Pl. Time: Second Monday evening of every month, except June, July, August and September.

RICHMOND OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. Samuel M. Cottrell, 116 E. Franklin St., Richmond, Va.
Secretary: Dr. Richard W. Vaughan, Medical Arts Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

Rochester Eye, Ear, Nose and Throat Society

President: Dr. R. E. Elliott, 78 S. Fitzhugh St., Rochester, N. Y.
Secretary-Treasurer: Dr. Raphael Farber, 280 Monroe Ave., Rochester, N. Y.
Place: Rochester Medical Association, 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

St. Louis Ophthalmic Society

President: Dr. Meyer Wiener, 308 N. 6th St., St. Louis.
Secretary: Dr. W. M. James, Metropolitan Bldg., St. Louis.
Place: Oscar Johnson Institute. Time: Clinical meeting 5:30 p. m., dinner and scientific meeting 6:30 p. m., fourth Friday of each month from October to April, inclusive, except December.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. William D. Gill, 323 Medical Arts Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. Frank Steed, Nix Professional Bldg., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Frank H. Rodin, 490 Post St., San Francisco.
Secretary: Dr. Louis F. Morrison, 490 Post St., San Francisco.
Place: Society's Building, 2180 Washington St., San Francisco.
Time: Fourth Tuesday of every month except May, June, July and December.

Shreveport Eye, Ear, Nose and Throat Society

President: Dr. John T. Crebbin, 624 Travis St., Shreveport, La.
Secretary-Treasurer: Dr. J. A. Wilkinson, Medical Arts Bldg., Shreveport, La.
Place: 1240 Texas Ave. Time: 7:30 p. m., first Monday of every month except July, August and September.

Spokane Academy of Ophthalmology and Oto-Laryngology

President: Dr. S. D. Brazeau, 407 Riverside Ave., Spokane, Wash.
Secretary: Dr. J. B. Stone, 1105 Paulsen Medical and Dental Bldg., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. Arnold B. Kauffman, 104 W. Onondaga St., Syracuse, N. Y.
Secretary-Treasurer: Dr. W. J. Werfelman Jr., 725 State Tower Bldg., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.

Toronto Academy of Medicine, Section of Ophthalmology

Chairman: Dr. Samuel Mortimer Lyon, 122 Bloor St. W., Toronto.
Secretary: Dr. A. Lloyd Morgan, 86 Bloor St., West, Toronto.
Time: First Monday, November to April.

Washington, D. C., Ophthalmological Society

President: Dr. James M. Greear Jr., 1740 M St., N. W., Washington, D. C.
Secretary-Treasurer: Dr. Ernest Sheppard, 927 17th St., Washington, D. C.
Place: Episcopal Eye, Ear and Throat Hospital. Time: 8 p. m., first Monday in November, January, March and May.